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THE KING PENGUIN (APTERODYTES PENNANTII).

BY W. B. TEGETMEIER.

(With a Coloured Plate.)

Few events have occurred more interesting to European ornithologists, who have never visited the Southern Hemisphere, than the recent arrival of the King Penguin at the Zoological Gardens, Regent's Park.

From time to time various efforts have been made to bring to England specimens of different species of the extraordinary group, constituting the family *Spheniscinæ*, but these have always hitherto proved failures. For the possession of the individual whose portrait is so correctly given in the coloured plate, the Zoological Society were indebted to Commander William Fenwick, of H.M.S. Harrier, who brought the bird from the neighbourhood of the Falkland Islands.*

The family of the penguins (*Spheniscinæ*), which includes several distinct genera, comprises unquestionably the most aquatic of all birds. Flight, the usual means of progression of the class to which they belong, is entirely denied them. On land their progress is slow and comparatively awkward, but in the water their movements are rapid and easy to an extreme degree. In swimming and diving their speed surpasses even that of the majority of fishes. They sport and seek their food safely during the heaviest gales, and spring from the water in play with such rapidity, that they cannot be distinguished from leaping fish, and as they feed their beloved young on the rocky islands of the southern seas, they recal to mind the exquisite lines of Shelley, as—

* Notwithstanding the care taken of the penguin at the Zoological Gardens, it unfortunately died.

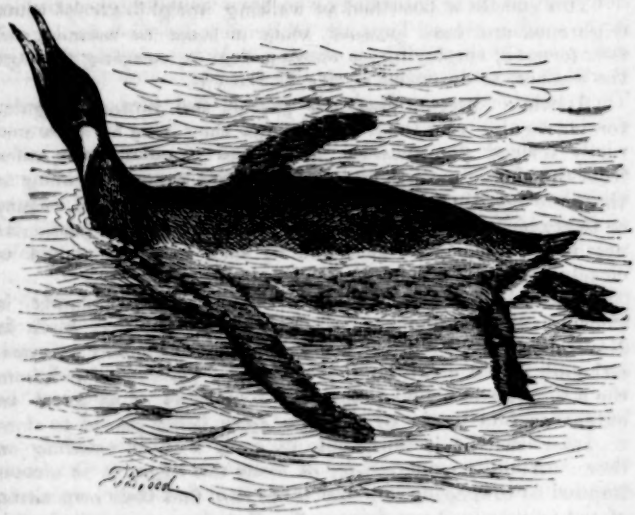
"Outspeeding the shark
And the sword-fish dark,
Under the ocean foam;
And up through the rifts
Of the rocky cliffs,
They pass to their Dorian home."

In the water but little is known of their movements, as the opportunities of observing them have necessarily been very limited. On land, however, their movements and mode of life are more open to investigation, and from the singularity alike of their structure and habits, they have attracted much attention from all those naturalists who have visited high latitudes in the southern seas. Thus Mr. G. Bennett describes a colony of one species of these birds as existing at Macquarie Island, in the South Pacific, and covering an extent of thirty or forty acres. Their number was immense, many thousand birds constantly passing to and from the sea. He states: "They are arranged when on shore in as compact and in as regular ranks as a regiment of soldiers. The females hatch the eggs by keeping them between their thighs, and if approached during the time of incubation, move away, carrying the eggs with them. At this time the male goes to sea and collects food for the female, which becomes very fat. After the young is hatched, both parents go to sea and bring home food for it, and it soon becomes so fat as to be scarcely able to walk, the old birds getting very thin. They sit upright on their roosting places, and walk in the erect position till they arrive at the beach, when they throw themselves on their breasts to encounter the heavy seas met with at the landing place."

Like almost all birds they are valiant in the defence of their eggs and young. The late Admiral Fitzroy, who commanded the exploring expedition in H.M.S. Beagle, speaking of the multitude of penguins in the thick rushy grass "tussac" of the shore of Noir Island, states "they were very valiant in self defence, and ran open-mouthed by dozens at any one who invaded their territory, little knowing how soon a stick would scatter them on the ground. The young were good eating, but the old were dark and tough when cooked. The manner in which they feed their young is curious and amusing. The old bird gets on a little eminence, and makes a great noise between braying and quacking, holding its head up in the air as if it were haranguing the penguinery, while the young one stands close to it, but a little lower; the old bird having continued its clatter for about a minute, puts its head down and opens its mouth widely, into which the young one thrusts its beak, and then appears to suck from the throat of its mother for a minute or two, after which the clatter is repeated, and the

young one again feeds, and this continues for about ten minutes."

Mr. C. Darwin describes very graphically the behaviour of one of these animals whose retreat to the sea was intercepted by him:—"One day, having placed myself between a penguin (*Spheniscus demersus*) and the water, I was much amused at watching its habits. It was a brave bird, and till reaching the sea it regularly fought and drove me backwards. Nothing less than heavy blows would have stopped him, every inch gained he firmly kept, standing close before me, erect and



KING PENGUIN SWIMMING.

determined. When thus opposed, he continually rolled his head from side to side in a very odd manner, as if the power of vision lay only in the anterior and basal part of the eye. This bird is commonly called the jackass penguin, from its habit while on shore of throwing its head backwards, and making a loud strange noise very like the braying of an ass. While at sea and undisturbed, its note is very deep and solemn, and is often heard in the night time. In diving, its little plumeless wings are used for fins. When at sea and fishing, it comes to the surface for the purpose of breathing with such a spring, and dives again so instantaneously, that I defy any at first sight to be sure that it is not a fish leaping for sport."

The different species have very different modes of making their nests and incubating. Of one species, the jackass penguin, breeding in the Falkland Islands, situated in 51° south latitude, Captain C. C. Abbott writes: "Thousands visit the land in October, to burrow in the soil and deposit their two white eggs in the deep hole that they have excavated." He observes that the habits of these animals are affected by the proximity of man, as at places remote from settlements the holes are comparatively shallow, but near to human habitations they are much deeper, so as to prevent the eggs being taken.

This species is described as walking upright, except when frightened and hard pressed, when it loses its balance, and falls forward, employing its wings as legs in escaping through the tussacs, as described by Mr. C. Darwin.

Another species, *Eudyptes papua*, the gentoo penguin, forms regular rookeries, or perhaps they may be more correctly termed penguineries, sometimes situated even miles from the shore, and far removed from salt water. Leading to these are regular paths, along which detachments of twenty or thirty birds may be seen marching at a time. No particular nest is formed, but the eggs laid by each bird are placed as closely together as the animals can stand.

A third species, common in the Falkland Islands, is known as the rock-hopper. It lays during the first week in November, on the cliffy slopes near the fresh-water streams, although, like the gentoo, it is constantly passing to and from the sea. The breeding-places are sometimes of as great an extent as 500 yards by 50, the eggs being placed so close together that it is impossible to walk without treading on them. Amid the multiplicity of nests and eggs, it is almost impossible to imagine how the birds can find their own nests, after having once been driven off. Yet they appear to do this without difficulty, each walking straight back to its own nest, and placing the eggs between its legs with the utmost care, so as to bring them both in contact with a bare space in the centre of the lower part of the body; the male, when not fishing, standing up alongside of the female.

Cormorants are described as breeding close to the penguins, both species associating in harmony.

Not so, however, the predaceous skua gull, that watches for an unprotected nest, and destroys the eggs or young, in the absence of the parents.

Having described the habits of these birds, as existing in a state of nature, I am desirous of saying a few words as to their extraordinary structure, and its correlation to their peculiar mode of life.

The entire family of the Spheniscinæ are characterised by their short fin-like wings, which are covered with dense scale-like feathers. The tail in all the genera is composed of rigid narrow feathers. The tarsi, usually so long and leg-like in birds, is excessively short, the feet flat and webbed, the hind toe being very small, attached to the inner toe, and directed forwards.

The family includes four genera, Spheniscus, Eudyptes, Pygoscelis, and Apterodytes. In the genus Spheniscus, to which the common jackass penguin, *S. demersus*, belongs, the upper mandible is hooked, and the lower truncated, so as to give the beak somewhat the character of that of an albatross. Eudyptes includes the crested penguin, or rock-hopper, *E. Chrysocome*, the description of whose habits has been already quoted from Captain Abbott, a species which is found in all the seas of the Southern Hemisphere, sometimes hundreds of miles away from land, M. Lesson having noticed them in south latitude 43° 8′, and west longitude 56° 56′.

In Apterodytes, the most interesting genus to us at the present time, the bill is nearly straight, slender, bent slightly at the tip, and longer than the head, both mandibles being pointed.

This genus contains two species, that were formerly confounded under one name; but they were distinguished by Gray, in his *Genera of Birds*, and named *A. Fosterii*, the emperor, and *A. Pennantii*, the king penguin.

The outward form of the king penguin is admirably given in the drawings of Mr. Wood. The erect attitude, the mode of progression, the peculiar form of the body, and the singular fin or flapper-like character of the rudimentary wings are all made evident; but there are in the internal structure of these singular birds many curious modifications which require a passing notice.

The skeleton, as may be readily imagined, is most peculiarly formed. The bones composing it are hard, dense, and compact. Unlike those of aërial voyagers, they do not contain air, but their cavities are filled with oily marrow. The air-cells which in ordinary birds surround the different viscera, and so aid in producing the extreme buoyancy required for flight, are small and rudimentary in the penguin.

The bones of the upper extremity are peculiarly adapted to the aquatic habits of the bird. The scapula or blade-bone, narrow in all birds as compared with its size in mammals, is very straight and unusually large at its posterior or lower extremity. The whole of the bones of the fore limb are thin and flat, so as to constitute a thin paddle that can be passed edgeways through the water, as it is brought forwards prepa-

ratory to making a propelling stroke. Two of the bones of the carpus or wrist are remarkably large. Of the metacarpal bones, or those corresponding to the palm of the hand in man, two only are developed, supporting respectively the middle and little finger. The thumb bone, which in most birds is found supporting the little winglet, is entirely wanting.

In the feet the tarsus or portion of the limb usually covered with scales, and generally but incorrectly termed the leg or shank, is excessively short, and is placed on the ground in walking, so that the animal moves with a plantigrade step. The muscles constituting the flesh are peculiar, being excessively firm and of a dark red colour. The pectorals—those on the breast which move the wings—are singularly arranged. In the greater number of birds, the outer muscle, which pulls down the wing and causes it to strike the air in its flight, is by far the larger, the one underneath, that serves to raise the wing, being much weaker; but in the penguin, where the wing has to be drawn forwards through so resisting a medium as water, the muscle raising the paddle or bringing it forward is greatly developed, and extends the entire length of the sternum.

The feathers are very peculiar; but little more than the mere shaft is developed, and this is so flattened, especially on the paddles, as to form a series of overlapping scales, much more closely resembling the covering of a fish than that of a bird. The feathers on the body are bent in the middle of their length, nearly at right angles, so that although the basal portion rises erect from the skin, the terminal ends overlap so as to form a close layer impervious to water. This arrangement, however, is not peculiar to the penguins, but may be found in almost all aquatic birds, the breast feathers of the common duck furnishing a good example.

The feathers of the tail are very peculiar, being stiff and spiny, so as to support the body, and form with the two legs the tripod on which the animal stands when in the erect position.

The bones of the tail, moreover, are strangely modified: in birds in general the last caudal vertebra is expanded into a share-shaped process, flattened from side to side. This is adapted to the support of the quill feathers used in flight. These are absent in the penguin, consequently the last bone of the tail is unexpanded; and as another remarkable peculiarity, the absence of the oil gland, or uropygium, may be noticed. It is strange that this gland, which is generally so very large in ducks and other water-birds, should be absent in the most aquatic of all; the explanation most probably is that the scale-like plumage of the penguin does not require oiling to

prevent the entrance of water, like the softer plumage of the duck.

As in all diving birds, the internal veins (*venæ cavæ*) of the penguin are immense in size, and serve as reservoirs for the impure venous blood, until the return of the animal to the surface enables it to be purified by breathing.

One more point respecting the structure of these singular animals, and I have done.

In almost every other bird that exists, the pupil of the eye is circular; in the penguin it is an elongated slit, a variation to which their singular mode of looking at an object, noticed by Mr. C. Darwin, is most likely due, and which has probably some direct reference to their subaqueous mode of life.

THE PIGMY OWL.

GLAUCIDIUM GNOMA, WAGLER.

Strix passerinoides, Tem.; *Strix infuscata*, Tem.; *Glaucidium Californicum*, Sclater.—The Medicine or Death Owl of the North-West American Indians.

BY J. K. LORD, F.Z.S.,

Late Naturalist to the British North American Boundary Commission.

THIS rare and beautiful little owl, the smallest of all the North American species, I shot for the first time on Vancouver Island. It has also been obtained, though rarely, in Oregon, Washington territory, and California.

The habits of this tiny bird appear little known; its diminutive size, shy, solitary habits, always hiding amongst the thick foliage of the oak or the pine, except when feeding, renders the task of observing it, or obtaining a specimen, at all times difficult; hence a few dried skins, from which its generic and specific characters have been determined, are the only records we possess. How the recluse lives, where he lives, or what he does, are secrets only revealed to the wanderer or naturalist, who, on the sunlit prairies, and in the gloomy forest, sees for himself how its denizens conduct themselves—in this manner the following notes were gleaned: missing pages in the history of the *Pigmy Owl*, which I here venture to supply.

Early in the spring, whilst collecting the migrants, which arrive at Vancouver Island in great numbers and variety of species—some to remain the summer through, and others only

to rest awhile, as they journey further north to their breeding grounds. Dame Fortune, fickle though she generally be, deigned for once to smile, and afforded me an opportunity I had long desired, to watch the habits of the pigmy owl. Two of these strangers selected as their home a gnarled and twisted oak (*Quercus garryana*), that grew alone on an open patch of gravelly ground near a small lake. Close by this lake was the remains of an Indian lodge, that had been once used as a fishing station, affording me a capital place of concealment, to watch the manners and customs of these—to the aborigines—potent and much-dreaded *spirits*. My camp was not far away, thus enabling me to reach my hiding-place at the first blush of morning. No sooner did the rosy light creep down the valley and spread over the plain, than the owls were up and stirring—evidently hungry from a night's fasting, for, like a well-conducted couple, they retired early to rest.

Their flight, short, quick, and jerking, similar to the movement of the sparrow-hawk, quite unlike the muffled, noiseless flap of the night-owl, as it sails along over marsh and meadow, in pursuit of mice and lizards, or any benighted rodent that has incautiously strayed too far from its place of safety. The food of this little owl is entirely insectivorous; its favourite morsel a fat grasshopper, or field cricket—not that it by any means refuses or objects to breakfast on an early riser, be it beetle or butterfly, that, like the proverbial worm, is so devoid of prudence as to permit the early bird to gather it.

When in pursuit of food, the owls perch on a small branch, near the ground, sit bolt upright in an indolent and drowsy manner, until their quick eye detects an insect moving on the plain; they then pounce suddenly upon him, hold him down with their small but powerful claws, and with their sharp curve-pointed beaks tear the captive to pieces. The hard wing-covers and thighs, if a cricket, or the wing-shields, if a beetle, are rejected, only the soft abdominal parts being eaten. Hunger satiated, they return to their tree, and, cuddling lovingly together, sit and doze away their time, protected from the blazing rays of the mid-day sun by the leafage of the sturdy oak. Breakfast disposed of, and the preparations completed for the diurnal siesta, I used to abandon my post and, like the owls, eat, and indulge in a refreshing sleep under some shady covert. Thus rested, the remainder of the day was passed in collecting, or preserving what I had already obtained, until the murmurs of the forest gradually dying away, the softened light, hovering round each peak and crag, warned me of the sun's departure. Again betaking myself to my lair, I awaited the owls' reappearance.

As near as possible to the mergence of twilight into night —what the Scotch call the *gloaming*, and in our country is known as *cock-light*—when the woodcock skims through the grove, and the blackbird chink-chinks his vesper hymn—exactly at this time the owls invariably came out, and, as if for the purpose of stretching their limbs rather than feeding, took erratic flights round the tree, and up and down the plain, chasing one another and performing all kinds of inexplicable manœuvres. Occasionally they settled on the ground, but never remained long. I do not think they ever capture an insect whilst on the wing, and a very small quantity of food appears to satisfy their wants. As it became dark, having supplied their evening necessities, again they returned to their dormitory, and, as I imagine, slept away the night.

In their habits they appear to have nothing in common with the typical owls (*Striginæ*), and approximate, though slightly, to the day owls (*Nycteininæ*). Cassin, in his *Birds of California*, calls this owl *Glaucidium infuscatum*, regarding it as the *Strix infuscata* of Temminck. Dr. Sclater, however, proposes to call it *Glaucidium Californicum* (*Proceedings Zoological Society*, 1857, page 4). There can be no doubt that the two names, *Strix infuscata* and *Strix passerinoides*, were used by Temminck to designate the same species, which is strictly from South America, and quite distinct from our little friend, though closely allied. The name *Gl. gnoma*, used by Wagler, I adopt as having precedence.

Its specific characters need not be given here, being readily obtainable by referring to any of the list of works quoted in the synonymes. I may mention, however, that the grand and marked specific differences, as distinguishing this from the South American species, are that in *Gl. gnoma* the toes are naked, the colour generally lighter, and the size somewhat less. Total length of male, 7 inches; wings 3¼, tail 3. The sexes are very nearly alike, but the female rather the larger, and more thickly spotted with white.

Early in May, two small white eggs were laid—round, and very rough on the surface—a large knot-hole in the branch of the oak being selected as the nesting-place; not a particle of anything was used as lining, the eggs being deposited on the bare wood. The length of time occupied in incubation I regret inability to state, having to shift my camp some distance away soon after the female commenced sitting. When next I visited the tree, both young and old were gone, much to my disgust and annoyance. By the scattered feathers that lay ominously beneath the tree, I imagine a prowling martin, or fisher, had played havoc with my pet family, and devoured, perhaps, both parents and children.

The Indians, without exception, hold this little owl in terrible dread; to see one in the day, or to hear its feeble cry, not unlike a stifled scream, is a fatal omen to *brave* or *squaw*—the hearer or a near relative is sure to die ere the end of the moon. To kill one is an unpardonable heresy; I nearly got into very serious trouble for shooting a specimen of this little owl. An Indian deputation, headed by their chief, waited on me, protested against my risking theirs and my own inevitable destruction. All reasoning was futile, and there was nothing for it but to procure all mystic birds and mammals by stealth.

It is a curious fact that owls, in every part of the world, have always been deemed birds of ill omen. The crumbling ruins of an ancient monastery, the old tower in the ivy-clad castle, and the ghost's chamber in a haunted house, are invariably associated with owls and goblins grim.

Pliny, in his Natural History, when speaking of birds of evil, says: "The owl is a dismal bird, and very much dreaded in public auguries; inhabits deserts, that are not only desolate, but dreary and inaccessible; it is a monster of night, nor does it possess any voice, but a groan."

Virgil alludes to it as foreboding the death of Dido:—

> "Solaque culminibus ferali carmine bubo
> Sæpe queri et longas in fletum ducere voces."

Shakspeare, too, saddles this poor bird with the guilt of ominous predictions.

Casca, in alluding to the events preceding Cæsar's death, says:—

> "And yesterday the bird of night did sit,
> Even at noonday, upon the market-place,
> Hooting and shrieking."

In Egypt, in bygone years, if the Pacha presented a gentleman with a drawing, or any representation of an owl, it was meant as a polite hint to the recipient of the gift, if he did not dispose of his own life, the powers supreme would save him the trouble. More modern poets rarely scandalise or malign the owl's character: as knowledge of the physical sciences has become diffused, so the mists of superstition have vanished, and modern writers, even in poetic composition, truthfully allude to its habits.

Coleridge, in *Christabel*:—

> "'Tis the middle of the night by the castle clock,
> And the owls have awakened the crowing cock."

Again Longfellow, in *Hyperion*, speaks of the owl "as a monk, that chaunts midnight mass, in the great temple of nature."

With every Indian tribe I have ever met with, either east or west of the Rocky Mountains, the owls, whether large or small, are always held sacred, their feathers being worn as charms by the medicine men, or conjurors, of the tribes. It is perhaps fortunate for the owls they are so dreaded. There are many Indian traditions I could relate, where terrible calamities have invariably followed the warnings of the pigmy owl, but space forbids.

Why such an exquisite type of Creative Wisdom—beautiful in plumage, retiring in habit, harmless, and gentle—should inspire terror and aversion, are mysteries I must leave to wiser heads than mine to solve.

SOUNDS WE CANNOT HEAR.

BY SAMUEL DREW, M.D.

Most persons, if asked whether insects possessed voice, would either at once say that they did not, or would consider the humming, or buzzing, of the various winged insects as vocal, which would be as erroneous as to confound the whir made by a covey of partridges in rising, with their call to one another after being scattered.

I, however, think that most probably the greater number of insects have voices, and that we have certainly no proof to the contrary. I do not imagine that insects possess any mode of audible communication of a very complex character, still less that they have anything like articulate speech, which their anatomy almost forbids; yet that animals, which unmistakeably do communicate with one another, and some, if not all, of which have auditory organs, should do so by determinate and intelligible sounds is certainly likely. Of the fact that they do communicate intelligence to one another no one who has ever carefully watched an ant-hill, or bee-hive, can entertain a doubt; indeed it is barely possible for the complicated arrangements of such communities to be carried on otherwise.

True we can hear no voices, for the ceaseless hum of the bees can no more be considered vocal than the tramp of a regiment of soldiers could be. Is, however, our hearing no such sound any proof that no such sound is given out? I think not.

Some years ago, when a student at the University of Edinburgh, and attending the lectures of Professor Donaldson,

I witnessed the experiment of sounding a set of small organ pipes of extreme acuteness of tone. The Professor slowly and regularly opened the air-valve of one pipe after another, beginning with the gravest, the sound of which we all heard, not only distinctly but disagreeably in its shrillness. "What a *squeal* it is!" whispered a fellow-student to me. "Ah! now it's quiet, that's a blessing," said he, as a yet more acute pipe was sounded. "Quiet!" I replied, "why, it's twice as bad." "I can believe my own ears, I imagine," was the rejoinder, "and I *know* the *squealing* has ceased." After two or three other pipes of constantly increasing acuteness had been sounded, I whispered to him rather loudly, supposing the experiment to be concluded, "Now, it is really stopped." "Bosh!" muttered a Scotch lad, just by, "If ye canna hear yon skreigh your ears are no that good."

To the utter amazement of all of us, we found that we could not at all judge of one another's powers of hearing for shrill sounds. Several persons were unable to hear notes which to me were perfectly clear and distinct; while what appeared to me complete silence, was to others broken by an ear-piercing shriek.

What appeared most singular was that the power of hearing more or fewer of these acute notes bore no relation to ability to catch slight sounds, or to the loudness of the note sounded.* It was not a matter of more or less distinctness of sound, but absolutely of sound or no sound. A person standing close to the instrument when a note too acute for his hearing capacity was given forth, could no more hear it than if he had been ten miles away, although it might seem to his neighbours but little shriller than the note immediately preceding, which he had heard as well as they could do; yet to him this was no sound at all.

Before the smallest pipe of the tiny organ had been reached, all present had ceased to hear the sounds produced, and we knew, merely from seeing the action of the bellows, or feeling the rush of air through the little tube, that a note was being sounded, although to us totally inaudible.

From various experiments with the "Siren," it has been shown that the human ear can, under favourable circumstances *of intensity*, distinguish as continuous sounds vibrations ranging from fourteen to sixteen in the second of time up to

* The *pitch* of a sound depends upon the number of vibrations in a given time. Its *intensity* depends on the amplitude of the oscillation. Loudness, or intensity, when carried to extremes, was found by Savart to have a material influence in enabling persons to hear sounds to which they were deaf under ordinary circumstances. The statement in the text is true within the usual limits of intensity.—Ed.

quite forty-eight thousand vibrations in the same time.* As there is some reason to suppose that those persons who can best distinguish very acute, are least able to hear very grave notes, we may probably assume that a range of about twelve octaves, as expressed in musical notation, includes the hearing capacity of human ears; to all vibrations of greater or less rapidity, such ears are absolutely deaf. To produce this range of sound on an organ would require pipes varying in length from 140 feet to about the third of an inch.

No reason whatever can be assigned why vibrations not included in such a scale should not, though quite inaudible to us, be distinguished as sounds by ears adapted for the purpose, and whose range of hearing, though perhaps not more extensive than our own, embraces a different series of notes. This is rendered more probable by the fact that the ordinary voices of many small animals do but just come within the range of the human ear.

To many persons the voice of the common shrew-mouse is inaudible; some cannot hear the sound of the cricket; and a few are deaf to the chirp of the house-sparrow. Very few persons are conscious of the scream of the common bat. Though well enough acquainted with that animal, I can hear no sound uttered by it. I have *seen* a bat scream when I have held it in my hand—that is, I judged from its struggles, and the action of the jaws and tongue that it was shrieking—but I could hear no sound whatever. Yet a friend, who hears more acute notes than I can, tells me that bats are very noisy little creatures.

The average tone of the human voice is not far from holding the middle place in the range of sound audible to the human ear—being about six octaves above the lowest, and six octaves below the most acute sounds distinguishable. Should the range of hearing of the bat be as extensive as our own, and, as is likely, hold about the same relative position with regard to its voice as ours does to the human voice, it would follow that sounds would be audible to the bat which were six octaves higher in tone than the most acute audible to us. Such sounds would require two and half millions of vibrations in the second to produce them.

The voice of the bat is probably the shrillest sound audible to human ears, consequently all animals whose voices are still more acute are, as far as our senses are concerned, completely mute. It does not, however, at all follow that their muteness

* M. Despretz gives thirty-two vibrations in a second as the limit of deep sounds; and 73,700 for acute sounds.—See *Ganot's Physics*, by Atkinson. Savart gives seven to eight vibrations in the second as the lowest limit of audibility when the sound is *very* loud.—Vide *Lardner's Handbook*, "Acoustics."

is absolute. That we cannot hear them is no evidence whatever that they cannot hear one another. As a general rule, the more minute animals have the more acute voices—as from the laws of acoustics might be expected—and though there are exceptions, as in the case of the frog; yet the acuteness of voice, and probably the range of hearing, usually bear relation to the size of the animal. It is therefore almost certain, judging from the size alone of insects, that we should be unable to hear any voices which they may possess, except perhaps in case of a few of the larger of them, as the death's head moth, the cicada, the grasshopper, and the cricket.

If it be once admitted that insects and other minute animals may, and probably do, utter or make determinate sounds or voices, which we cannot perceive, we may readily imagine them to have, like birds, sounds expressive of alarm, or of encouragement, of want, or affection, of pleasure, or distress, and to be well enough able to communicate with one another. An ant-hill or a bee-hive may be to the inhabitants as noisy as a rookery appears to us; the sound of a spider may be to a fly as terrific as the roar of a lion is to an antelope; while the bat may distinguish the voice of the moths on which it preys, as readily as the wolf hears the bleating of the sheep.

A singular converse proposition is also probable, namely, that insects which can very well hear one another, do not hear us at all; that to the house-fly, or cricket, men, women, and children may appear utterly dumb. Certainly many insects are quite unaffected by the human voice, and, at least, appear insensible to any sound from it. Even the exquisitely-developed ears of the bat may be unable to hear all the notes of human voices, just as the human ear often cannot hear the bat's voice.

It is stated by Scoresby and other arctic voyagers and whale hunters, that whales have some mysterious mode of converse with one another at a distance of some miles, so that an alarm of danger is rapidly communicated, and this without any sound audible to human beings being used. Some entirely unknown mode of signaling through the medium of water has been imagined to explain the fact, but it is more likely that the whale simply bellows in a graver tone than ordinary—a tone below the auditory range of the human ear, and therefore not to be heard by it, although quite within the auditory range of the whale itself. It will, of course, be understood that by voice I merely mean any voluntary and determinate sound given forth as a means of communication, whether the vocal organs be internal, as in the higher animals; or external, as they probably are in the lower.

THE GENUS ARAUCARIA.

BY JOHN R. JACKSON,

Curator, Museum, Royal Gardens, Kew.

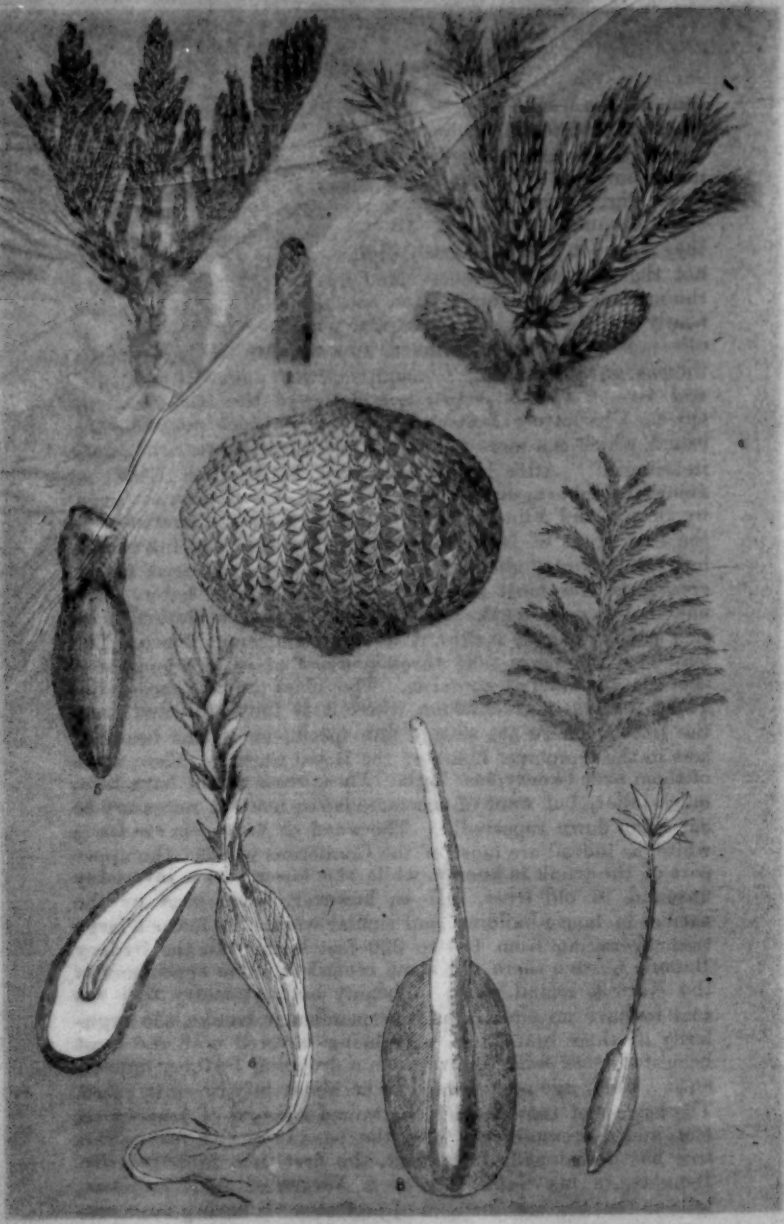
(*With a Tinted Plate.*)

In the year 1774, the good ship "Resolution," commanded by the great circumnavigator Captain Cook, was calmly sailing along through those glorious southern seas, when the cry of "Land a-head" echoed through the vessel. All eyes were directed towards the point indicated. The faint outline of an unknown shore was visible. Gradually they neared the coast. The pleasure of those upon the deck was equalled by their surprise as by degrees the scene became more visible. They saw what appeared to them to be tall pillars, or spires, or the masts of a thousand ships, towering high over all else around them. On they sped without being able to determine what this unusual and unexpected sight could mean, till upon nearing Cape Coronation a few days after, the same objects presented themselves to view. What could they be? Could they be nearing a land where civilization held sway? or could these be magnificent columns of basaltic formation? This latter was the general opinion of the naturalists on board. Speculation was rife, expectation was on tip-toe. The enlightened Commander maintained from the first that they were trees. The telescope was kept pointed towards them, and at last it became evident that these strange pillars were, in fact, trees, but trees of a new and wonderful species. A landing was proposed, all hands being determined not to leave the place till they were satisfied as to what kind of trees they were. Captain Cook with the botanists on board now first set foot upon the island. The hearts of the enthusiastic company bounded within them at the sight, as they for the first time made the acquaintance of a goodly number of *Araucaria columnaris*. Nor was this discovery interesting alone to the botanists, here were trees the trunks of which on this little isle were from sixty to seventy feet high admirably adapted for ships' spars. Captain Cook says:—"If I except New Zealand, I at this time knew of no island in the South Pacific Ocean where a ship could supply herself with a mast or a yard, were she ever so much distressed for want of one. My carpenter, who was a mast-maker as well as shipwright, was of opinion that these trees would make exceedingly good masts. The wood is white, close grained, tough and light. Turpentine had exuded from most of the trunks, and the sun had inspissated it into a resin which was

found sticking to them and lying about the roots. These trees shoot out their branches like all other pines, with this difference, that the branches of these are much smaller and shorter, so that the knots become nothing when the tree is wrought for use. I took notice that the largest of them had the smallest and shortest branches, and were crowned, as it were, at the top by a spreading branch like a bush. This was what led some on board into the extravagant notion of their being basalts, indeed, no one could think of finding such trees here." This island was afterwards named by Captain Cook the Isle of Pines. We do not know whether at the time we write the particular tree that first attracted Captain Cook's attention ninety years since is still standing, but in 1850 it was reported to be "in a flourishing condition," and was said to exactly resemble "a well-proportioned factory chimney of great height." From the peculiarity of the foliage and general habit of Araucarias, and more especially of *A. columnaris*, it is certainly a matter of no wonder that all on board the "Resolution" were surprised and astonished upon first beholding so novel and beautiful a scene. There is, perhaps, no one family of plants more interesting than that to which the Araucarias belong (the *Coniferæ*), and it is certain of all the timber trees none have produced so much interest among botanists as the Araucarias. And there are many reasons for this, for if we except the Mammoth tree of California, the Araucarias take a position among the largest and most majestic forest trees.

To Captain Cook and his fellow-travellers, then, are we indebted for the first accurate general account of *A. columnaris*, though it had been previously mentioned by several authors, but under other names.

The Araucarias, which take their rank as the noblest of all that noble family of trees, the Conifers, are now confined to the Southern hemisphere; but there is evidence that would lead us to suppose that at one time they held a footing even in our own island. Geologists, and notably poor Hugh Miller, speak with confidence of having found fossil Araucaria stems. The microscopic structure of the wood corresponds very closely with that of the recent Araucarias. The remains of one found in the Lias of Dorsetshire have been figured and described under the name of *A. primæva*. There are some seven or eight species of the genus now known to botanists, and these are natives of Brazil, Chili, New Caledonia, Norfolk Island, Australia, etc. Some of them have been only recently introduced to our gardens, others have been cultivated for many years. A few particulars concerning them may not be without interest to the readers of this magazine. The name of the genus is derived from that of a tribe of natives called Arau-



ARAUCARIA.

canians (the word signifying freedom), who inhabit the district where *A. imbricata* abounds.

If *A. columnaris* holds good as a species, decidedly the most similar to it is *A. excelsa;* indeed, the difference seems to be so slight that many authors have united them under one specific name (*A. excelsa*). In general habit and appearance they so much resemble each other that to a casual observer not the slightest difference could be detected, without it is in the manner of branching, *A. excelsa* throwing out its branches nearly horizontally and in regular whorls, while those of *A. columnaris* are slightly inclined upwards, but this may not be the case in old plants. Loudon considers them synonymous, and says, "The *A. excelsa* is a native of New Caledonia, in Queen Charlotte's Foreland, and on a small neighbouring island, which is a mere sandbank, only three-quarters of a mile in circuit." After being discovered by Captain Cook, as mentioned above, on the Isle of Pines, it was brought home by Brown and Flinders, who found it growing abundantly on the east coast of New Holland, and the tree was introduced into this country about 1793. Of all the Araucarias the *A. excelsa* is the most beautiful and graceful in habit. Its naked, tapering trunk, with uniform branches clothed with rich green foliage, makes it a very handsome object. The leaves are not more than three-quarters of an inch long, awl-shaped, and curved upwards. The plant is not hardy, but grows well in a greenhouse, where it is fully protected from the frost. There are several fine specimens of this beautiful tree in the temperate house of the Royal Gardens, Kew, some of them over twenty feet high. These trees would have been much taller, but want of accommodation made it necessary to cut them down repeatedly. The wood of *Araucaria excelsa* is white, as indeed are most of the Coniferous woods; the upper part of the trunk is knotty, while the lower part is invariably unsound in old trees. It is, however, much used by the natives in house-building and similar work. It forms a large tree, averaging from 180 to 230 feet high. In the Sydney Botanic Garden there are some remarkably fine specimens of the Norfolk Island pine; in beauty and symmetry they are said to have no equal; their perpendicular trunks, the regularity of their branching, and being covered with the most beautiful dense foliage, give them a drooping feathery appearance. Their age is computed to be about fifty or sixty years. The largest of these trees has attained a height of seventy-six feet, and a circumference near the base of twelve feet. This tree has occasionally born fruit, the first time in 1839. Dr. Bennett, in his *Gatherings of a Naturalist in Australasia,* tells us that the first instance of perfect seeds having been pro-

duced in that colony was in 1857, when the trees at Ash Island, Hunter's River, bore female cones. The seeds, upon ripening, scattered themselves, taking root and producing young plants spontaneously, thus naturalizing the plant as it were.

A. excelsa is of all the species the most majestic, and the places of its growth perhaps the most picturesque. It loves the mountain side, the overhanging precipice, the storm-torn rocks; among these it firmly anchors itself with its twisting roots. These roots descend many feet into the ground and penetrate into every lateral crevice. They form wood of some thickness and of great density, of a deep red colour, from which the inhabitants make small articles of utility or ornament, such as candlesticks and the like. From the tremendous storms with which Norfolk Island is occasionally visited, the Araucarias suffer considerably, but chiefly in their uppermost branches; in the valleys where they are more sheltered, therefore, the best formed and most symmetrical trees are to be found. They do not grow in very dense forests, other and smaller trees coming in and filling up the spaces between them, thus tending to give the forests a very ornamental appearance. The wood is free from any resin, but a sort of white milky juice exudes from the bark: this has been tried for various purposes as a substitute for pitch, but found to be useless. A former governor (Governor King) of Norfolk Island was so partial to this tree that he adopted it as his family crest. Another species of this group, and nearly allied to *A. excelsa*, is *A. Cunninghami*. This, which is called the Moreton Bay pine, was named by Aiton in honour of the indefatigable botanist and explorer Allan Cunningham. It is found on the shores of Moreton Bay, in lat. 14° to 29° south, and on the alluvial banks of the Brisbane River, lat. 27° to 30° south. It grows, however, in the greatest profusion in the brush forests, on the Richmond River. The trees seem to thrive best near the coast, attaining in such a situation their greatest height, often from 100 to 130 feet, but gradually diminishing in height the farther the trees are inland. It would appear from this that the sea air has a great effect upon it. Other large trees of different genera are found growing amongst the Araucarias in dense woods. The Moreton Bay pine was discovered in 1770, by Sir Joseph Banks and Dr. Solander, and the first living plant did not arrive at Kew till 1824.

From the time of the discovery of *A. columnaris* in 1774 up to 1824, the two trees were considered to be the same species, but in the latter year Mr. Allan Cunningham revisited Moreton Bay in company with Mr. Oxley, and, after a careful examination, came to the conclusion that *A. Cunninghami* "was a very distinct species, not simply in its habit of growth,

which is very remarkable, but in the character of its leaves." The branches are much more drooping than those of *A. excelsa*, and very lax as compared with that species. On the young twigs the leaves are very minute, gradually developing themselves till they attain maturity, when they become slightly imbricated. The branches are given off in whorls of six or eight, in the young plants slightly bent upwards, but in those of greater age bending down in a very graceful manner. It forms a very straight trunk, frequently rising to a height of eighty feet before any branches are given off. The diameter of the trunk averages from four to five feet, the cones are ovate, from three to four inches long, and nearly as broad. The scales are very closely set together, wedge-shaped, of a leathery texture, each ending in a sharp recurved spine, about a third the length of the scale. The seeds are small and flattened, in form resembling the scale itself. The whole cone is of a deep rich brown colour. Allan Cunningham says that this plant bears young cones in the month of September. It has never fruited in this country. The wood in appearance and colour much resembles some of the lighter kinds of deal. It is of a very uniform grain, and works well. Some specimens are very beautiful, on account of small knots interspersed throughout, giving it somewhat the appearance of bird's-eye maple, though being of a lighter colour it has a more delicate appearance. It is chiefly used in the colony for house carpentry and many kinds of furniture. For the masts of vessels it is peculiarly adapted when green, as spars can be obtained in any quantity, from eighty to a hundred feet in length; but it is said in drying, these masts cannot be depended on, as there is little lateral cohesion between the fibres, and being entirely devoid of resin, there is nothing to strengthen them. The timber procured from the inland or mountain brushes is considered superior to that grown near the coast; from some trees as much as ten thousand feet of saleable timber can be obtained. From Sydney, and other parts, large quantities are imported, giving employment to a large number of sawyers, who receive pay at the rate of £2 10*s.* per thousand feet. In Queensland, also, the timber is an article of great commercial importance. Though there is no actual resin deposited in these trees, there is an abundance of a clear, white, transparent substance, which exudes from the trunks and adheres to them, hanging in the form of icicles. Some fine specimens of the wood of this tree were exhibited in the International Exhibition of 1862, in both the Sydney and Queensland collections. These are now to be seen amongst the magnificent collection of colonial and foreign woods in the Royal Gardens, Kew.

The *Araucaria imbricata*, Pav., or Chili pine, is, perhaps,

the best known of all the species, having of late years been so largely planted in this country. It was known to the Spanish settlers nearly a century back. In 1780 Don Francisco Dendariarena was commissioned by these settlers to examine the Araucarias, and report upon their suitability as timber for ship-building. The result was that the wood of *A. imbricata* was considered good, and at once applied to the repairing of the vessels of the squadron then lying in the port of Talcaguano. In a work published by the Abbate Molina, two years later (1782), the tree is described as *Pinus Araucaria*. In the same year the botanist Pavon was sent by the Spanish Government in search of this tree; having secured the flowers and fruit (the most necessary parts for determination), he had no hesitation in making it a distinct species of Araucaria (*A. imbricata*). The plant had, however, been gathered by Pavon in a previous expedition to Chili, and transmitted by him to France, where falling into the hands of Lamarck and Jussieu, the former authority named it *Dombeya Chilensis*, but through inaccuracies in the description of its botanical characters, this name fell to the ground, and Pavon's subsequent name was generally used. The tree was not known in Europe in a living state till Archibald Menzies, accompanying Captain Vancouver, secured some fresh seeds.

Having been invited to dine at the house of one of the officials, at Valparaiso, he begged a few of the seeds of this tree, which formed part of the dessert. These were planted, and carefully attended to by him on board ship; thus young plants were brought home, and were presented by Menzies to Sir J. Banks, who reared one in the garden adjoining his house at Spring Grove, and the remainder were presented to the Royal Gardens, Kew. One of these trees is now among the finest in Europe, and stands our winter climate well. Previous to 1806 it was kept in a greenhouse, but after being planted out it was carefully covered, to protect it from frost. This precaution has now been discontinued for many years, and found to be quite unnecessary, as the abundance of these trees in almost every well-kept garden testify. Plants can now be obtained for a few shillings which about twenty years since could only be had for as many pounds. The best description of the Chilian Araucaria forests is from Pœppig's travels in the Peruvian Andes. He says: "The Araucaria—a tree that affords the Indians of the Patagonian Andes a great part of their food—will not grow on the lowlands, and it also preserves an accurately defined boundary with respect to its northern limits. When transplanted into many parts of the province of Concepcion, it exhibits a sickly, deteriorated appearance, and vegetates so reluctantly that from many fresh seeds which

were sown in Talcahuano, only two sprung up, which shortly afterwards died. An Alpine atmosphere and a severer climate than can be expected in the lower tracts of the country, and above all a stony soil, seem to be indispensable for its growth. In the immediate neighbourhood of Antuco not a single tree of Araucaria can be seen, and it requires a fatiguing excursion to gratify the naturalist's desire to behold a wood of these truly regal trees." The writer then goes on to say: "Towards the evening we had ascended the moderately high ridges that form the background of the valley," which runs between Antuco and the fort of Trun Leuvu, "and the dense crown that was seen above these, from afar, had indicated our near approach to the desired aim, and added new vigour to our exertions. When we arrived at the first Araucarias, the sun had just set, still some time remained for their examination. What first struck our attention were the thick roots of these trees, which lie spread over the stony, and nearly naked soil, like gigantic serpents, two or three feet in thickness; they are clothed with a rough bark, similar to that which invests the lofty pillar-like trunks, of from fifty to one hundred feet in height. The crown of foliage occupies only about the upper quarter of the stem, and resembles a large depressed cone. The lower branches, eight or twelve in number, form a circle round the trunk; they diminish till they are but four or six in a ring, and are of most regular formation, all spreading out horizontally, and bending upwards only at their tips; they are thickly invested with leaves, that cover them like scales, and are sharp-pointed, above an inch broad, and of such a hard and woody texture that it requires a sharp knife to sever them from the parent branch. The general aspect of the Araucaria is most striking and peculiar, though it undeniably bears a distant family likeness to the pines of our country; its fruits, placed at the ends of the boughs, are of a regularly globular form, as large as a man's head, and consist of beautifully imbricated scales, that cover the seeds, which are the most important part of this truly noble tree. The Araucaria is the palm of those Indians who inhabit the Chilian Andes, from lat. 37° to 48°, yielding to these nomade nations a vegetable sustenance that is found in the greater plenty the more they recede from the whites, and the more difficult they find it to obtain corn by commerce.

"Such is the extent of the Araucaria forests and the amazing quantity of nutritious seeds that each full-grown tree produces, that the Indians are ever secure from want, and even the discord that prevails frequently among the different hordes does not prevent the quiet collection of this kind of harvest. A single fruit (*cabeza*, 'a head') contains between 200 and 300 kernels, and there are frequently twenty or thirty fruits

on one stem; and as even a hearty eater among the Indians, except he should be wholly deprived of every other kind of sustenance, cannot consume more than 200 nuts in a day, it is easily seen that eighteen Araucarias will maintain a single person for a whole year. The kernel, which is the shape of an almond, but double the size, is surrounded with a coriaceous membrane that is easily removed. Though relishing when prepared, it is not easily digestible, and containing but a small quantity of oil, is apt to cause disorders in the stomach with those who are not accustomed to this diet. When the scarcely matured seeds are dried in the sun, a sugary substance exudes, which appears to reside chiefly in the embryo. The Indians eat them either fresh, boiled, or roasted, and the latter mode of cooking gives them a flavour something like a chesnut. For winter's use they are dried, after being boiled, and the women prepare a kind of flour and pastry from them.

"The collecting these fruits would be attended with great labour if it were always necessary to climb the gigantic trunks; but as soon as the kernels are ripe, towards the end of March, the cones drop off of themselves, and shedding their contents on the ground, scatter liberally a boon which nothing but the little parrot and a species of cherry-finch divide with the Indians. In the vast forests, of a day's journey in extent, that are formed by these trees in the districts of Pehuenches and Huilliches, the fruits lie in such plenty on the ground, that but a very small part of them can be consumed. In former times a great quantity came to Concepcion and Valdivia by trading with the Indians, and thence they found their way to Valparaiso and Lima; but now they are seldom seen anywhere near the coast, or they are too old to be palatable. The reason why all the seeds of Araucaria that hitherto were sent to Europe did not vegetate, is because the collectors did not procure them from the Indian country, but bought them in the market at Valparaiso, where they are offered for sale boiled and dried. My excursion to Quillay-Leuvu obtained for me fresh seeds of the Araucaria, which reached Germany in October, 1829, being seven months after they were ripe, and being sowed immediately, the period was just that of the Chilian spring. Of some hundreds, about thirty came up; but ignorance of the true climate, which led to the error of placing the young plants in a hothouse, killed the greater part during the first year. To my great satisfaction, however, about six individual plants have been preserved in different places, and they are to the best of my belief the only ones in Europe. The wood of the Araucaria is red where it has been affected by the forest fires, but otherwise it is white, and towards the centre of the stem bright yellow. It yields to none in

hardness and solidity, and might prove valuable for many uses if the places of the growth of the tree were less inaccessible. For ship-building it would be useful, but is much too heavy for masts. If a branch be scratched, or the scales of an unripe fruit be broken, a thick milky juice immediately exudes, that soon changes to a yellowish resin, of which the smell is agreeable, and which is considered by the Chilians as possessing such medicinal virtues that it cures the most violent rheumatic headaches when applied to the spot where the pain is felt."

"The Araucaria forest of Antuco is the most northerly that is known in Chili, so that the boundary of this king of of all the extra-tropical American trees may be estimated at 36° south lat. The extreme southern limit is not so clearly ascertained, which is not surprising when we consider how little comparatively is known of Western Patagonia; it seems probable, however, that it does not stretch far beyond lat. 46°. Between Antuco and Valdivia this tree only grows among the Andes, and, as the Indians assert, solely on their western declivities, and nowhere lower than from 1500 to 2000 feet below the snow line, up to which they frequently reach. Further to the south the Araucaria appears at a lower elevation, and in the country of the Cuncos, and about Osorno, is said to occur on mountains of a very moderate altitude near the sea. The Corcovado, a mountain that rises opposite Chilöe, is said to be studded from its foot to the snow line with large groups of these beautiful trees. Of all other vegetation the Araucaria forests are as bare as the pine woods, offering but few plants which can interest the botanist. Steep rocky ridges, where there is no water, are its favourite habitat."

The Chilians eat the seeds either raw, roasted, or boiled, and consider them very nutritious; they also procure a spirit from them by distillation. The timber is easily worked, and takes a high polish. Pavon mentions a peculiar fact connected with the height of these trees. He asserts that the female is by far the largest, frequently 150 feet, while the male seldom exceeds 40 or 50 feet. The inner bark of the trunk is peculiar from its light porous nature; it is very thick. The outer bark is also of a great thickness, and of a similar corky consistence.

The Bunya-Bunya, *Araucaria Bidwilli*, Hook., is a noble tree, inhabiting the scrubs between the Brisbane and Burnett Rivers, between the 26 and 28 parallels of latitude, and longitude 152° to 153°·30 east. On the east coast of Australia the trees grow in dense forests over a tract of country ranging about thirty miles long by twelve broad, where they form one of the principal features in the surrounding vegetation, being strikingly contrasted by their rigid growth and bright green colour. The

tree is a magnificent one, growing from 100 to 200 feet high, with a stout trunk, scarcely tapering, and covered with a thick smooth bark, often unbranched for half the height, with a conical loose head, overtopping all the other trees of the forest. The branches are arranged in whorls, sometimes giving off near the summit as many as sixteen in a whorl; these branches average twelve feet in length, and about one and a-half inches in diameter. The young branches are arranged horizontally on the stem, but the older ones have a drooping habit. The branchlets are disposed in pairs, opposite, about eighteen inches long, very slender, sparsely covered with the thin long leaves; in the younger and terminal branches the leaves are more crowded. The cones are very large, quite the size of a man's head, and sometimes nearly as broad as long, the top often slightly depressed. The scales are large and thick, with an acute ridge running across them, terminating in a sharp-pointed recurved spine. The seeds, seated between these scales, are also very large, frequently from one to two inches long, and sometimes even longer, and quite three-quarters of an inch wide, broad at one end and tapering at the other. The cones are produced on the uppermost branches of the tree, and one cone frequently contains as many as 150 seeds, which are freely scattered on the ground as the cone ripens. The trees bear fruit plentifully once in three years, usually between the months of January and March. At these seasons the aborigines assemble from far and near to collect the seeds, which are a favourite food with them. They roast them in the shell, crack them between two stones, and eat them while hot. In flavour they somewhat resemble roasted chesnuts. So well does this food agree with them that they are said "to grow sleek and fat" upon it. That part of the district where these trees most abound is called the Bunya-Bunya country.

The trees are protected by an act of the Colonial legislature, forbidding their destruction under heavy penalties, as they form one of the natural sources of food of the natives. One of the most remarkable things connected with these trees is the division of them as personal property among the various tribes, each tribe owning a particular group, which passes from generation to generation as an hereditary right, and, with the exception of these, they are not known to possess any property in a similar manner. The wood is very fine and close-grained, of a lightish yellow colour, sometimes beautifully veined; it is very durable, is easily worked, and is susceptible of a high polish.

The Brazilian Araucaria, *Araucaria Brasiliensis*, Rich., is found growing at a great elevation, chiefly in the province of

Minos Geroes, and to the north of Rio, at an altitude of 1000 feet above the sea-level. They are exposed to some of the most violent storms, accompanied by the fiercest of lightning, from the effects of which the trees suffer considerably—their beauty and symmetry being greatly lessened by the stripping off of their lower branches, or the shivering of the younger and more tender parts. The height of the tree itself adds greatly to the chances of injury, as it attains from 70 to 100 feet, having a very straight trunk, which is covered for the most part with a smooth bark, except near the summit, where the remains of old leaves still persist, as on the trunk of *A. imbricata*. In its habit it is more loose and spreading than that species, but more nearly resembles it than any of the other species. From the date of its introduction in 1819 to 1822, *A. Brasiliensis* and *A. imbricata* were considered as one species. In the latter year, however, M. Richard, who had paid some attention to the two plants, published a description of this species, separating it from *A. imbricata*, and giving the plant its existing name of *A. Brasiliensis*. He states in that account that the chief botanical difference is, that in this species the seed is entirely devoid of the winged appendage, which is a distinctive mark of *A. imbricata*. The disposition of the branches also was made a character for distinction, as well as the greater softness and whiteness of the wood. The branches are arranged in whorls round the stem, but much more numerous than the other South American species. The form of the leaves s linear-lanceolate, very sharp at the apex, from one to two inches long, not so thickly disposed upon the stem as in *A. imbricata*.

The cones are more close and compact than those of that species; they are of a dingy yellow colour, about six inches long. The scales are of a soft, corky nature, thick, and wedge-shaped, very closely packed together, each having a long recurved spine. In general appearance, this tree is much more spreading and loose than *A. imbricata*, and it makes a more rapid growth. It is not hardy enough to bear the frosts of our winters, but thrives well in a greenhouse. The nuts, or seeds, are commonly sold in the markets of Rio Janeiro, as an article of food. The resinous matter which exudes from the trunk, mixed with wax, is much used by the natives in the manufacture of candles. Two species similar to this have been described: the first by M. Savin, under the name of *A. Ridolfiana*—this has been proved by Professor Parlatore to be nothing more than a form of *A. Brasiliensis*. The second by Professor Parlatore, who has given it the name of *A. Saviana*, and considers it a very distinct species. This plant is growing in the Botanic Garden of Pisa, where it was

planted in the open air in 1846, and is now a flourishing tree. It may also be seen growing in the Botanic Garden of Florence, in both of which it has borne cones. These, in their young state, strongly resemble *A. Brasiliensis*, with the exception that the spines of the scales are much longer, very uniformly recurved, and curling so far back as to completely cover the junction of the two scales. So dense are the spines on these young cones that the scales are completely hidden by them, and the cone much more resembles a fine head of Fuller's teazel than the fruit of a Coniferous tree. In the mature cone the scales are much more fully developed, and the spines have the appearance of small recurved hooks.

The newest of all the Araucarias, and perhaps one of the most remarkable, whether as to its place of growth or its habit, is the *A. Rulei*, Muell. This was first known in England in 1861 or 1862, when small specimens of the foliage were received by Sir W. J. Hooker, at Kew. The native habitat of this species is very limited; the whole of the trees as yet discovered occupying a radius of only half a mile, and this on the summit of an extinct volcano, where the changes of season produce the greatest extremes of drought and heat, or rain, and cold winds, and where no other vegetation exists for hundreds of feet below. It grows on a parallel lat. with *A. Bidwilli*, but situate at double the elevation of the habitat of that tree. It was discovered and introduced from Port Molle, by Mr. W. Duncan, collector to John Rule, Esq., of Victoria, in honour of whom Dr. Mueller has given it its specific name. It is a tree rising some 50 or 60 feet high, branching in like manner to *A. imbricata*, but the branches more thickly arranged round the stem, and these of a more rigid and tabular form, forking in all directions, at equidistances, in a most symmetrical manner. The leaves are very closely imbricated, of a dark shining green colour. Its nearest affinity is with *A. imbricata*, which it resembles in a remarkable degree in many points, but in others it is wholly distinct. Its beauty is said far to surpass the last-named species, or even of any other species known. The cones are nearly spherical, the scales about an inch broad, terminating with a long projecting narrow point, or scale, about an inch long. Of the economic uses of this species nothing is yet known, though it is probable the seeds are eaten like some of the other species. Mr. W. Bull, the well-known nurseryman, of the King's Road, Chelsea, introduced this rare plant into this country.

The following, from an account of two Araucarias, one of which is *A. Rulei*, is given by Dr. Mueller, in his report on Lieut. Fitzalan's expedition:—"*A. Cunninghami*, found on Cumberland Islands, occurs southward to the vicinity of the Hastings

River. The branches, with immature fruit, gathered during the Burdekin expedition, accord fully with others from Moreton Bay, Rockhampton, and the Hastings River. It remains as yet unascertained whether more than one Araucaria belongs to the East Australian flora. Mr. Fitzalan offers on this pine the following notes: Very abundant from Percy's Island upwards. On Percy's Island it differs but little from the Moreton Bay pine, except in the invariable regularity of its branches—these being in regular tiers, opposite. The Moreton Bay pine is seldom so. As we go further north, this regularity increases, and the foliage becomes more glaucous, until, at Port Molle and on Whitsunday Island, the tree assumes the habit of the New Caledonian species, the tree being conical, the tiers of branches perfectly regular, and having a slight droop at their tips. We cut a spar of it on Magnetical Island, to make a top-mast, and the wood was hard and close grained, paler than that of the Moreton Bay pine, and would not swim. It produces a white resin abundantly."

HABITS AND HAUNTS OF THE BROWN AND BLACK BEARS OF THE HIMALAYAN MOUNTAINS.

BY A. LEITH ADAMS, A.M., M.B., F.G.S.

The European brown bear (*Ursus arctos*), although at one time common in many parts of Europe, is now restricted to a few secluded valleys in the Alps, Pyrenees, and mountains of Norway and Lapland. The dark-coloured race, long considered a distinct species, under the name of the European black bear, together with the barren-ground bear of North America, are now included among the varieties of *Ursus arctos*. The distribution of the brown bear is more extensive than any of the family. In Asia it inhabits Siberia and the Altai as far westward as Japan; when the Altai is crossed, and the great Himalayan chain examined, there will be found another brown bear, which has been named the Isabella bear, from the prevailing light fulvous or Isabella colour of the fur. There is a condition, common to all the above, and more or less apparent at every stage of the animal's growth, which is a light or white coloured collar; this is very distinct in the young or unborn cub, and in particular during the shedding of the long winter coat in midsummer; consequently it was from a specimen procured at that season that Cuvier described his "Collared bear." It would seem, moreover, that the fur on the front of the chest is lighter than on other parts of the body in almost

every member of the family, just as other markings—to wit, spots and stripes—can be more or less traced throughout otherwise very dissimilar species of the same group.

As to the distinction between the *Ursus arctos* and the Isabella coloured bear of the Himalaya, it will be found that the difference rests only in the colouring of the tips of the hair, and that, we have frequently observed, is not always a sure criterion, as we have procured many specimens of the bear in which the fur was in every way similar to that of the other. No doubt the majority of the Isabella bears have the tips of the hairs brownish white, but brown is the fundamental colour. Some individuals, especially old males, are almost maroon, whilst others vary from brown to brownish yellow, and are a dirty white; hence travellers speak of the "White and Brown bears of Cashmere": it is evident, however, that neither age nor sex determine the colour with any degree of accuracy. We have frequently remarked, however, that the lighter coloured individuals were mostly observed in spring, and at high elevations, as if the long sojourn among the snow had brought about the change in the tips of the hairs. In the Himalayan brown bear the senses of sight and hearing are not nearly so highly developed as smell, in which it would appear the animal's safety mainly depends. This peculiarity seems more or less constant in every member of the family. There are few quadrupeds supposed to be more inactive in habits than the bear; but this is a great mistake, and has arisen doubtless from observing the inmates of menageries and zoological gardens: when aroused to exertion in the wild state, it will scamper along a mountain side at a pace equal to the sharp gallop of a horse, and in ascending heights would certainly soon outstrip any of its plantigrade congeners. When the first skin of this bear was brought to Europe, and described by Dr. Horsefield, it was supposed from the curved and sharp claws that the animal is an expert tree climber: this, however, we can vouch for, is not the case; moreover, as a rule, the claws are not very acute, but well adapted to maintain a sure footing on the slippery mountain sides and glaciers.

The Isabella bear is found on the mountains of Armenia, where it has long passed under the name of the "Syrian bear," and is perhaps the animal referred to in the Bible; a few still linger on the Lebanon, and from the continued intercourse between Egypt and the East, it is highly probable that this is the species mentioned by ancient historians as the "Lybian bear." It is not rare on the Caucasus and high ranges of Persia, Affghanistan, and Himalaya, at least as far eastward as Nepaul, and probably much farther.

Its extreme northern limits have not been accurately de-

fined; it abounds on all the high ranges forming the watersheds of the great rivers of Hindoostan, and is essentially Alpine in habits, whatever it may have been in bygone times; at present it is seldom found under 8000 to 10,000 feet above the level of the sea. Like its European congener it is fast disappearing before the march of civilization. Nowhere was the animal more abundant, until late years, than among the snow-covered peaks and upland valleys of the Northern Cashmere ranges. In the Vale of Wurdwun as many as thirty were killed during the spring of 1851 by one hunter; and in the same neighbourhood, two years subsequently, we procured upwards of twenty in a few weeks. The native name of the bear is *Reech*, not Ritch, as frequently written; it is also called the *Harput*, and *Balu*, names by which the black bear is also known. The Isabella bear swims with ease, and has been known to cross many of the most rapid mountain streams. In spring, after issuing from its winter retreat, its food consists mainly of grass, green pine-cones, the tender shoots of divers sorts of wild rhubarb, and umbelliferous plants then just appearing above ground; but as the season advances, it grows more dainty, feeding on the root of the wild strawberry, and a small white carrot, which it digs up with its snout and paws. At first, when food is scarce, it has been often known to attack sheep, goats, even cattle and ponies; we have frequently watched individuals prowling in the neighbourhood of a flock of sheep, in spite of the loud clamours of the herdsmen, who informed us that additional shepherds were necessary to protect the herds in the spring season, in consequence of the bears and wild dogs being then more predatory than at other times. It is fond of crunching whatever stray bones may happen to come in the way; we have seen an Isabella bear gnawing the tops of the cast antlers of a deer, and often noticed antlers similarly mutilated lying about in the forests of Cashmere. Major Young, 37th Regiment, an indefatigable and experienced Himalayan hunter, informed us that he killed an Isabella bear devouring a hind of the Cashmere deer (*Cervus Wallichii*), which in all probability it surprised when bringing forth young, as a newly-born fawn was lying by the mother's side. It has been known to devour the carcase of its own species, and the bodies of ibex, musk-deer, etc., engulphed in avalanches are greedily sought after when the snow melts in spring, and the devastating epidemics among cattle, brought on from starvation and severe winters, furnish it with abundance of animal food at a time when its system requires support. The winter's coat is shed about midsummer, when the old hair and under wool, called *peshmena*, hang in matted masses on its sides. The bear's *peshmena* is not at-

tained until autumn, and after the new coat has gained considerable length. It is analogous to that of the wild and tame goats and sheep of Thibet, and more or less pervades all the quadrupeds of the high and snowy ranges; moreover, the pheasants, partridges, finches, and other birds have their winter plumage remarkably soft and downy. We need scarcely remark that it is this substance which forms the celebrated Cashmere shawls. The *peshmena* of the ibex is softer than that of the tame goat of Thibet. Although larger and more powerful than the black bear of the Himalaya, the Isabella bear readily turns tail when confronted by its rival. We have often watched two individuals unconsciously approaching each other even within a few yards, when, as soon as they became aware of their proximity, with a grunt sable bruin rushed on his foe, whilst the other beat a hasty retreat, and only distanced his pursuer among rocky and precipitous parts, where the brown bear always finds himself the better cragsman; we have often come accidentally upon Isabella bears asleep on snowdrifts and in hollows of glaciers, where the animal is fond of basking in the heat of the day, chiefly for coolness, but also to escape annoyance from insects. In spring it feeds at all hours, but when strength and vigour return, and supplies are ample, it prefers the night and cool of the morning, possibly for the same reasons. Its fur is infested by a large flat parasite, which evidently occasions great discomfort and irritation, driving the animal to seek ponds and rivers, where it bathes frequently. The dimensions of the Isabella bear vary considerably, old males sometimes measure 7½ feet in length, and stand as high as 3½ feet at the shoulder. The average length, however, is about 6½ feet, and 4 to 4½ for a she-bear. It is generally distributed over the Alpine forests, and when it regains its vigour in spring seldom remains long in one locality; there are, however, certain individuals (usually old males) that select spots where they remain for years, most commonly a steep ridge running up to a bed of snow, where the animal's den is situated, whilst below, a pool or spring in a shady situation, serves its wants for drinking and bathing; such hermit bears seldom roam far from their retreats, and by constantly treading in the same footprints, wear out hollows on the softer soil, like "steps of stairs," which may be seen extending in unbroken succession for long distances.

Several killed by us were all very old he-bears, with their teeth considerably worn, and not a few had the canines broken or worn down to a level with the other teeth, whilst the molars were perfectly smooth on the crown. It would appear that the bears of other countries, and several other animals, such as the lion, tiger, deer, etc., when old take themselves to

retired places. This is an important fact, to be kept in view by geologists in connection with the cave remains of the large extinct quadrupeds. As to the boldness and ferocity of this bear, it may be remarked, that it seldom ever stands on the defensive; we have often seen natives approach wounded individuals, and beat them with sticks, whilst all Bruin attempted was to turn his hinder quarters towards his assailant, and moan most lustily; like its congeners, however, it is very tenacious of life, and unless wounded in a vital spot, is almost certain to make its escape. The power of vision of the bear is by no means strong, especially in spring, after it has left its den; at that season, provided the wind is favourable, an expert hunter may get within a few yards; we have actually walked up to a bear and stood before it as the animal continued to browse upon the tender shoots of plants, quite unconscious of our presence. This defect is not the result of stupidity, for when the animal scents man, all its energies are instantly called into play. On examining the eyes of several killed in spring, we have often noticed a hazy condition of the cornea, which was especially remarked in those reared by natives. This opacity may be the result of disease of the organ during hybernation, or perhaps the animal is subject to ophthalmia in the wild state, as is frequently the case in domesticated bears. We have been often astonished in witnessing the extreme acuteness of its power of smell, even at the distance of a mile: when the wind is favourable an individual may be often observed to start suddenly as if alarmed by some unfriendly sound or object, and in a wild and excited manner rush about with its head raised snuffing the wind, until satisfied by repeated trials that all was not right, when, turning tail, it scampers off at a rate few observers would credit who have only seen the inmates of a zoological garden.

The Thibet, Malayan, and Bornean bears represent the genus Helarctos, or Sun bears. The first (*Ursus Tibetanus*) is a native of the lower Himalayan ranges, decreasing as we ascend, and disappearing entirely with the forest region. The geographical distribution of this species has not been clearly fixed, and it is unfortunate that Thibet should have been selected as its habitat, inasmuch as neither that elevated region, nor Ladakh, are frequented by the animal. The Thibet bear is said to be found in Persia, Affghanistan, and Northern China, but we are not aware that it has been traced with any degree of accuracy eastward of Nepaul, or westward of the Indus. The white mark on the front of the chest, more or less apparent in almost every species, but particularly so in that under consideration, is shaped like the letter Y, the two legs proceeding a short distance up the side of the shoulder. The

general colour is a fine and glossy black, with a white spot on the lower lip, and large bushy whiskers. There is a variety we have seen among the Sewalik hills, along the frontiers of the Punjaub, having the latter spot rust coloured, with a tinge of the same on the paws. All we examined of this variety were relatively smaller than the others, a circumstance which might be accounted for in some way by the warmer climate and food in the sub-Himalayan valleys compared with the same at higher elevations. The Thibet bear, when taken young and reared, seldom attains the dimensions of wild individuals. The adult often measures 5½ feet from the snout to the root of the tail. The favourite haunts of the bear are the thick forest jungles in the neighbourhood of cultivation, where it spends the day, and issues forth at dusk to feed on Indian corn, fruits, etc. It climbs with ease, and is often seen perched on the highest branches of walnut and other fruit-trees. On making its descent, and in particular when alarmed, it will let itself "go by the run." Among the dense jungles along the sides of the Duchinpara and other great valleys leading from the Vale of Cashmere, both this and the last species often repair in the autumn to feed on walnuts and other fruits. It is said by the native hunters that as the Isabella bear cannot climb he waits until the other ascends, and then feeds on whatever black Bruin knocks down. It feeds mostly at night, repairing to dense forests and jungles at daylight. The farmers of the lowland valleys dread the destructive propensities of the black bear more than any other of their four-footed foes; in consequence, they erect platforms in the fields, where watchmen are posted at night beating drums and making loud noises to frighten the unwelcome intruders. Bruin, however, soon gets accustomed to the sounds, and like the wild boar, pays very little attention to such demonstrations. Like its brown congener, certain individuals repair to secluded places, where they spend their days much in the same manner, contenting themselves with whatever wild plants are procurable in a short circuit around their retreats, and invariably choosing the neighbourhood of some tank or spring, where the even tenour of their ways becomes apparent from the deep impressions on the ground leading to and from their dens.

The Thibet bear is decidedly herbivorous, and seldom, unless when pressed by hunger, will eat flesh. Like the Isabella bear, it delights to bask in the sun, but only during the colder months; the great heat of many of the valleys in midsummer drives it to seek shelter in the jungles and forests. Its fur is thick and long in winter, but does not contain much of the under wool called "peshmena." Like many other species, it is partial to honey, and in eating ripe walnuts it crunches

them between the jaws, rejecting the shells with great nicety. In districts where food is procurable in abundance it may be seen in undiminished numbers throughout the winter. We have been frequently assured, however, that the she-bears repair to dens soon after the first fall of snow in December, and are rarely seen until the end of February, when generally accompanied by one, sometimes two, and rarely three cubs. It would appear, therefore, doubtful if this species does hybernate; at all events it is not an universal habit. When come on unawares, especially if accompanied by its cubs, it has been known to attack man and inflict severe injuries. Like other species, the mode of attack is by a rush towards its opponent, then rearing on its hind legs fells him to the ground with its paws. Sometimes it secures its victim, and after a desperate hug or bite, scampers off into the nearest jungle. We have frequently witnessed individuals when suddenly alarmed by the report of a gun, or otherwise, rush down the steep, but as if not content with the rapidity of the stampede, would coil themselves in the form of a ball, and bound down the incline for several hundred yards; if brought to a standstill by a projection or shelf, they would spring to their feet, and hastening to the edge of the declivity, once more gather themselves into a round mass and roll to the bottom. Towards the end of October, after this bear has fed on fruits and grain, like its congener, it becomes very fat. The native hunters state that the kidney fat is useless as an article of commerce on account of being tainted with the smell of the animal's urine. They accordingly preserve only the external adipose on the loins and inside of the thighs.

The fossil remains of bears found in the Upper Tertiary formations and caves of Europe and America lead to the belief that there at one time existed certain species either now extinct or belonging to larger races than any now met with. Moreover, the same may be said of several of their contemporaries belonging to such, as the hyæna, tiger, elephant, deer, etc.; for instance, the great cavern bear, the cave tiger, the mammoth, and Irish elk. Comparing the dimensions of living and extinct bears, it seems that the great cavern bear and the species or race of the brown or fen bears, that infested Europe even in the early historic times, approach nearest in size, whereas there is a greater difference in respect to the relative dimensions of the largest individuals of the existent brown bear and the fen bear of England, showing that the large individuals have died out, or that the race has greatly deteriorated. We believe, however, that among the present denizens of northern Asia and the Isabella bear of the Himalayan, specimens can be procured equal in size at least to the largest

bears yet found in the bogs and superficial drifts. It must, however, be remarked, with reference to this point, that the very old and very large Isabella bears form a small proportion in comparison with the lesser sized individuals, and comprehend for the most part the denizens of the caves we have before alluded to, where, in all probability, many end their days, and their remains are frequently enveloped in calcareous drippings, or other deposits.

Climate and modes of life doubtless play important parts in producing the external appearances of individuals called varieties; for it is not unreasonable to believe that by curtailing the liberty and changing the food of a wild animal, by driving it to seek new haunts and subsistence, which in its former condition it would probably have eschewed, we are establishing a new order of things in its economy, which in process of time is likely enough to affect its physical developments. On the other hand, it would seem fair to suppose that when animals are unmolested in their native haunts, and allowed to follow their own inclinations, with abundance of food suited to their growth and calculated to maintain them in full vigour, they occupy their natural position in creation; whilst by becoming restricted to narrower limits, and associated with man, or other dominant races, by whom they are driven to modify their habits of life, and compelled to submit for successive generations to degrading influences, it is only in accordance with every-day experience to conclude that a deterioration of race will result, but whether to the extent of producing changes in the form of the skeleton as well as in the dimensions and outward appearances of the animal, have not yet been clearly demonstrated.

CLOVELLY.

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CLOVELLY is without doubt one of the most remarkable places in the terraqueous globe. It is to an extraordinary degree queer, quaint, and beautiful. How it came to be at all is a mystery, requiring a combination of all the sciences to explain. When the visitor arrives within the precincts of its sunny woods, unless a wrinkle of blue smoke happens to curl among the trees, and the smoke suggests an unseen chimney, and the invisible chimney suggests a possible house, and the possible house suggests a possibility of lodgings, the prospect, though æsthetically beautiful, is not quite consolatory after a ride of eleven miles from Bideford to the edge of a precipitous hill, at the base of which fringed waves are playing, while flapping sea gulls and long-necked cormorants fly by. "Please, sir, I can't drive any further, but will show you the way to the lodgings," was the unexpected exclamation of our Jehu, as he pulled up in the situation described. Our party of three burst out laughing at this comical termination of a ride. In a moment a call and whistle from the driver brought a man up from the depths below, and to his care the vehicle and luggage were consigned, while we followed our guide to find Clovelly town. Where was it? Not down the green chasm immediately in front of us, as we faced the sea; for through the branching trees and thick waving ferns we could discern enough to decide that no house more elaborate than a rabbit's burrow lay in that direction between us and the mermaids' parlours that might be found beneath the glittering wave. Our guide plunged into a steep lane with bright red marly banks, and blocks of protruding stone. Trees grew on both sides, and flowers thick as in a garden. Down we went, joggling over rough stones, and after getting a hundred feet lower, between a walk and a stumble, we came to a broad stone staircase, and this, with its accompanying cottages, was Clovelly town. In days of yore, before Improvement came this way for the benefit of its health, the staircase was not in anything like its present state, but a breakneck mountain path, like a wriggling stony sheep track, occupied its place. Now, from the pretty white cottage occupied by the carrier at the top of the glen, down to the beach, 200 feet below, the stairs extend, beginning with an imposing width and breadth, and narrowing as they twist down to the coast. Clovelly houses are built on each side of this staircase, on landings; some have forecourts and some have

not, while many of the poorest cottages display fuchsias growing up their walls that would be highly honoured in less favoured climes. The Clovelly stairs are puzzling formations for strangers to walk up or down. They are much too broad to be taken in single successive steps, one for each descent. Each stair measures some variable and unequable multiple of a pace, and is, moreover, a steep inclined plane, diversified by gutter arrangements, the stones of which stand up like *snags*, and trip up any one who does not take heed unto his ways. Visitors stumble and boggle up and down Clovelly town, and feel disgusted with themselves, and envious of the natives, who—the women especially—glide skyward or seaward as though possessed of some mode of motion unknown to mortals born upon the flats.

We lodge very comfortably at Mrs. Marshall's, on stair number 33, and opposite us is a little opening called the "Square," across which we see hanging woods and the richly varied coast on the eastern side of Bideford Bay, with the Exmoor range in the distance, about twenty-six miles off in a straight line. In another direction our view is over the sloping roofs and gable ends of cottages lower down the stairs, and then across the sea to Baggy Point, and Morte, the end of the latter promontory with its "stone," terrible in the annals of shipwreck, being out of sight. Commencing above the village, and winding across several hill sides and valleys, is the road called the "Hobby," cut out of the rock, and traversing woods of remarkable luxuriance and beauty, composed of oak, beech, sycamore, firs, etc. To the west lie other woods, the park of Clovelly Court, and fine headlands with precipitous or sloping cliffs, in which the stratification is well displayed.

Clovelly is a charming place for a landscape artist, as it exhibits more colours than "Iris purfled scarf can show," and they vary magically under the changing influences of sun and cloud. A few days' residence in such a spot ought to be sufficient to emancipate any one, who has eyes to see, from the conventional prejudices and silly criticisms that hamper and damage our landscape art. One very striking fact, equally noticeable in many other parts of Devon, is the distance at which local colour is distinctly seen. When the sun catches the cliffs of crimson marl five or six miles off, they literally glow with the deeply-tinted light. Patches of spring corn shine like strips of pale green velvet at twice that distance, and fields on the slope of Exmoor, five and twenty miles away, are frequently to be discerned of a dull green hue, varied by dark lines of stone hedge-rows* and trees. In other and

* The fences are a mixture of hedge and stone wall. The latter is the fundamental structure, but so taken possession of by vegetation as to give it a hedge-like aspect.

hotter countries distant objects are much sharper in definition, and, so to speak, *harder* in tint. In Devon the magical blending of distinctness with softness is unsurpassed.

Geologically, Clovelly is situated on the millstone grit which underlies the coal measures—very imperfectly developed in Devon,—and under this general title of the formation rocks of considerable lithological difference are comprehended. The stratification has been subjected to powerful and complicated disturbances. It is plain, on the most casual inspection, that when the beds were last made they were remarkably well shaken. In many instances the strata are nearly vertical, and numerous cases occur—two remarkable ones a little west of the pier—in which hard firm beds of siliceous and aluminous stone have been bent like twigs into round arches, both inverted and erect. Angular arches are likewise common, and several adjacent cliffs have their strata thrown into a series of V or W shapes, mostly upside down. Further to the west, at Hartland Point and Quay, the rocks are less varied in colour and the hills more barren, but wilder and grander than at Clovelly. Near the latter place a wreck recently occurred, and when the tide is low the skeleton fragments of a ship caught in the sharp-toothed jaws of dark rocks, and surrounded by splashing foam, tells—at the time this is written—a striking story of the perils of the sea. The strata vary in texture from hard compact stones to easily splitting shales, with occasional marl. At Clovelly the colours are purple, brown, yellow, red, and grey; the natural tints are heightened and still further varied by the ironmould action of trickling water, and by glorious patches of orange lichen (*Squamaria murorum*), bright enough to be seen for miles, when many square feet of rock are covered with this gorgeous plant. The first artist who will do simple justice to these coasts will have his reward, if he perseveres. Of course the critics, whose eyes have never been purged of London smoke, will declare the most faithful transcript of what exists, to be "wrong," "impossible," "absurd," etc.; but when they have sung this song long enough, they will try another, laud Mr. ——'s genius and insight to the skies, and claim to have been the first to recognise his merits and proclaim how true to nature was each stroke of his brush.

Clovelly is a splendid home for ferns. How many species could be discovered in shady lanes, rocky clefts, and roads that range from the sea level to nearly 600 feet above it, only a very practised collector would venture to say. The most prevalent kinds are the lady fern, the broad fern, the male fern, the *Blechnum boreale*, the hart's tongue, and the black spleenwort, and *Polystichum aculeatum*. Of these the "ladies" grow with wonderful luxuriance, and the broad ferns, with wide

spreading fronds four and five feet long, are worth coming all the way from anywhere to see. Wherever the ferns grow flowers abound. At the end of May blue bells and rose lychnis were the most conspicuous, and in quantity sufficient to be noticeable half a mile off. With June foxgloves came in season, richer in the colour of their crimson-purple bells than the garden sorts, and commonly as high as a tall man. Near the coast sea pinks swarm, together with shepherd's purse. Lichens abound, the hairy sorts (*Usnea hirta, florida*, etc.) make a thick matting on the trees; the "oak lungs" (*Sticta pulmonaria*) is frequently found in the woods both east and west of the village, and is a very striking object, looking like extensive patches of oak leaves, some green, some brown, growing out of the bark. The cup lichens, which form beautiful low-power objects for the microscope, are plentiful in the Hobby, and rocks facing the sea are often covered with the scaly species, white, drab, yellow, orange, and black. Mosses vie with lichens in covering the banks and trees, the most conspicuous being the feather sorts, and the Polytrichums, with their flowers and long-stalked urns.

Fungi are no doubt found in considerable variety. We saw several sorts, and had practical experiences of three kinds. First, on the high ground near Hartland we gathered the giant puff-ball in its young state, when certain botanical writers pronounce it an epicurean luxury. We tried the experiment, telling the presiding genius of the kitchen, who was astonished at our desire to feed upon "toad-stools," to take off the outer skin, cut the balls into slices and delicately fry. The result was the appearance of a pretty-looking dish on our breakfast-table, and a jury of three was empowered to try the important case. The first decision was embodied in unanimous exclamations of "how nice, just like omelette, or fine batter." Second thoughts were less favourable, and a sickly aftertaste induced the experimenting triad to give up the "toad-stools," and resort to other food.

Our second fungoid adventure was in the Hobby woods one evening, when the clouds gave us a respite after some thirty-six hours of pelting rain. On arriving at a bend in the road our noses were greeted, but not gratified, by a stream of perfume not at all recalling gales from the "spicy shores of Araby the blest." The abominable and peculiar character of the stench suggested its probable origin, and a slight search revealed the offender to whose agency is was due, for among the more respectable but rank vegetation, up stood an impudent stinkhorn (*Phallus impudicus*) in the shape of a stout drab coloured column, ornamented with honeycomb markings, and surmounted by a nightcap of oval form. How "any

mortal mixture of earth's mould" can diffuse such a concentrated essence of abominations, vegetable chemistry may try to tell; but if any one has smelt the sylvan beauty he will easily comprehend Miss Plues' story of the gentleman who was driven from a favourite walk by an odour which he conjectured came from the decomposing bodies of animals that had died in the crevices of the rocks, but which really emanated from the un-Rimmel like laboratory which the stinkhorn had set to work.

Another day we brought in from the woods a small club-shaped fungus about an inch and a half high, and of a fine orange-yellow colour. As soon as it was placed under a three-inch object-glass it was seen to scatter a quantity of extremely fine threads about a hundredth of an inch in length. Mr. Berkeley was kind enough to give me the name of this fungus, *Cordiceps militaris*, and from him I learn that the emitted objects were threads of sporidia escaping from the *asci*, or bags, in which they are situated in the Sporidiiferous division of fungi. Under a magnification of 400 linear, the threads were seen to be very delicate tubes, containing patches of a whitish substance, some round, some oval, some square, and looking like a minute chain of irregular cells. The threads of sporidia did not appear to tumble out of the *asci*, or to be blown out by the air currents of the room. They escaped from all parts of the fungus and in various directions, as if ejected by an infinitesimal force.

In lanes between Clovelly and Bleckbury the *Osmunda* grows six feet high, and near Hartland Quay (eastward) is a beautiful patch of splendid *Asplenium marinum*, provokingly out of reach. The hay-scented fern is found in the Hobby woods, together with many interesting varieties of species less rare.

The shores of Clovelly are not very good for collecting specimens in marine zoology. The rocks and stones to the left are more splendid in appearance than convenient as dwelling-places for sea creatures. Some pools are prettily fringed with green weeds, common coralline, polysiphonias (good for the microscope), tangle weeds, etc.; but the compound polyps and polyzoa do not take to them, and few of the elegant tribe of sea slugs were found by us crawling on their clefts, or under sides. Some magnificent anemones—*crassicornis* and *Anther cereus*—were found at Clovelly and Hartland; the acorn barnacle was in millions on the rocks, together with swarms of tops and lesser whelks. A purple spotted top (*Trochus ziziphinus*) began to lay eggs as soon as it was placed in a washhand basin. They were discharged in ribbons of jelly, each egg, a round white opaque body, having its own separate envelope of a material transparent as the finest glass.

Near Hartland the dodder grass is plentiful on the furze, giving it a crimson tint, seen a long way off; and at Milford is a fine waterfall, making a descent of about 90 feet, and when seen from the beach, with a grand black rock mass behind, it is singularly picturesque. Rock plants of four or five kinds are in abundance, and probably many more might be found. At Clovelly the most noticeable is the pennywort, with its well known thick, round, dimpled leaves, and tall racemes* of wax-like flowers, not often seen in such perfection. London pride grows in wild profusion in the Hobby walks. Damp rocks in the roads are sure to be covered with the common liverwort, and the lycopodium shaped liverwort may be discovered nestled amongst feather mosses in wet clefts.

No description of Clovelly could be pardoned if it omitted the peculiar and interesting inhabitants of the comical stone stairs. Nobody seems to be rich in the little place; the best off are connected with the shipping that visits the bay, and next come the owners of the fishing vessels, who have unfortunately not had a lucky season for many years. The principal cottages let lodgings, and a few families fill the picturesque crack in the rocks when its season begins. Little favoured by fortune so far as her brilliant gifts are concerned, the Clovelly people are yet a distinguished race. No one can live a day on the stone staircase without perceiving that he is in a village of ladies and gentlemen. The girls have graceful figures, walk elegantly, and carry their pitchers to and from the fountains with unconscious but artistic skill. They all dress well; tawdry finery, and its natural ally, dirtiness, are both unknown, and many a London lady might advantageously exchange dress, form, and gait for those of a Clovelly damsel carrying a basket through the street. The men are manly-looking fellows, with frank, brown faces; in old specimens handsomely carved by sea and breeze. A bright, pleasant-mannered schoolmistress is the instructress of the girls, who seem to do credit to her care, and a big basket of beautiful children could be collected in five minutes on the rocky stairs.

Why Clovelly people are thus distinguished from the chawbacons and clodpoles to be found no great way off, could no doubt be traced to several causes. In the first place, they are evidently of a good race, and in the second place, their wits have been sharpened for successive generations by the risks and dangers of their amphibious life. Lastly, though few are well off, the majority seem well fed, and in former years the coast fishery was a profitable trade, as it may become again, whenever the fishes think proper to take excursion tickets for

* A form of inflorescence when the flowers are furnished with pedicels arranged at intervals upon a common axis.—Henslow's *Dict. Botanical Terms.*

the purpose of visiting these shores. All the villagers seem industrious, and they are very obliging, without a tinge of the servility too often found elsewhere. Of the internal life of the place a visitor can discern little, but the good folks seem intimately bound together by their common staircase, and by other ties.

Devonshire used to be famous for its superstitions; how much of the popular faith in weird wonders lingers in Clovelly we do not know, but one old woman who is lame with one leg owes her calamity to the credulity of her youth. At that time a girl of the village was declared to be possessed by the devil, and under the management of a local preacher, a ceremony of exorcism was performed in the presence of numerous witnesses. Prayers and exhortations, together with the howlings and contortions of the patient, brought the spectators to a high pitch of excitement, when suddenly the chief operator declared that the Evil One was skurrying through the bacon rack, making fast for the door. The crowd rushed back, and the old woman, who now goes lame, damaged her ankle by an unlucky fall.

This brief and imperfect sketch of Clovelly may be wound up with a few words on its climate and accommodation. Any tourist or visitor who has pretty strong legs, and is given to climbing, will be delighted with it. The New Inn, though small, is of good repute, and has serviceable vehicles and horses for hire. The lodging houses only number some half dozen. One or two are nicely furnished, and the rest are supplied with indispensables. Provisions of good quality are easily obtained by a little management, and learning the ways of the place; while any article not supplied by the village shops —which strangers would not always discover without assistance—can be had by ordering it through the carrier, who makes frequent journeys to Bideford. A little stream, locally and oddly termed a "lake," runs down the right side of the stone staircase. This tiny torrent, which is flushed once or twice a day, carries off rubbish and helps to keep the village healthy. East winds are pleasant companions, having somehow lost their sting. W., and S.W., and N.W. winds do not get sufficiently into all parts of the cleft in which Clovelly is built, but a good blow can nearly always be obtained on the hills, or on the beach. Those who can stand a moderate amount of fatigue, and like to be out of doors for hours together, need have no difficulty in getting an appetite; but the old or feeble will find the stairs and hills too much for them. Those who like fish must look sharp after it, as what is caught immediately passes into the hands of dealers, or "fish jowders," as they are termed, and dispersed through other towns by the help of donkeys, provided with panniers, who toil patiently up the stone stairs.

DIRECT VISION SPECTROSCOPES BY DOUBLE INTERNAL REFLECTION.

BY A. S. HERSCHEL, B.A.

In the manufacture of prisms for spectroscopic purposes the principle of double reflection, adopted in the construction of the ordinary pocket sextant, can be employed for correcting the deviation of the ray, which usually takes place in its passage through a prism. This discovery, as it appears to be of some importance, as well as novelty, will be treated in the following article with rather close attention to mathematical detail; but it is hoped that it will not on this account be any the less acceptable to readers of the INTELLECTUAL OBSERVER.

In the common sextant a ray of light from a distant object (A), falling in succession upon two plane mirrors B C (Fig. 1), is deflected from its course in such a manner as to be brought to coincide with the direction of a ray of light arriving from another distant object, *d*; when both objects become visible together in the field of a small telescope at D. The angular distance between the two objects is then *double of the angle contained between the two mirrors*; and is read off on the sextant upon a scale of equal parts, by a vernier and index revolving with the mirror B.

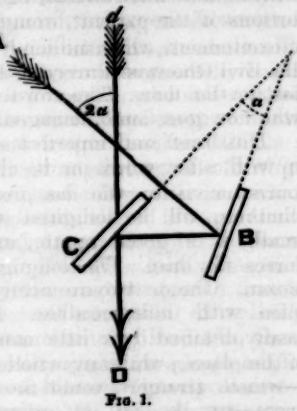


FIG. 1.

To apply this construction to the removal of deviation from the refracted ray in spectroscopic prisms, two reflections of the ray must be made to take the place of those of the pocket sextant, within the material of the prism. These internal reflections are in general total, and have the advantage over those of an ordinary sextant in occasioning no loss of light.

Suppose a prism of glass, A C D (Fig. 2), to be traversed, in any manner, by a ray of light S *a* D E, with a deviating angle amounting to 2 × A. This deviation will be completely removed by intersecting the prism by a plane, A B, making the angle A equal to half the deviation. At the same time the refracting angle at C must be increased by the whole amount (2 A) of the original deviation. The prism A C D is then replaced by a prism of a new form, A C B, and the portion *b* D E of the refracted ray is removed to *c d e*. The two internal reflections revolve the ray within the prism through *twice the angle* (A).

At the same time the prism-face C D has been revolved an equal amount. The ray is therefore refracted under the same circumstances as before, at its emergence, *but emerges parallel to its original direction*, D E *parallel to* S *a*.

It is evident that if i e are the original angles of incidence and emergence in the *un*corrected prism, these will still remain the angles of incidence and emergence when the deviation is removed. In this case $i + e = C$ C being the principal refracting angle of the corrected prism.* It is essential for distinct spectroscopic vision that these angles i and e, of incidence and emergence, should be equal to one another, and the deviation of the ray (in the uncorrected prism) a minimum; for otherwise the image of the spectrum is blurred, and the dark and bright lines are undistinguishable. In that case our last equation becomes $i = e = \frac{C}{2}$. It will be found on examination of the figure that the angle of *first internal reflection* also becomes equal to either of the three angles named in this equation. The angle of first internal reflection is therefore

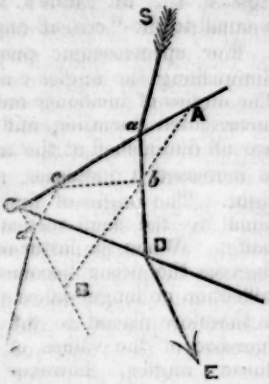


Fig. 2.

Table I.

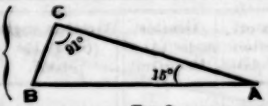
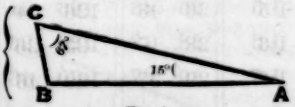
Index of refraction of the glass.	Least angle (A) of the prism.	Least angle (C) of the prism.	Extreme forms of prisms with least possible angles A and C.
1·4	15° 5′	91° 16′	
1·5	15 26	83 36	
1·6	15 41	77 20	
1·7	15 46	72 4	
1·8	15 45	67 30	

Fig. 3.

Fig. 4.

Scale of angles for a direct vision prism, in which first internal reflection takes place at the "critical" angle of the glass. The angles A and C have their least possible values consistently with no loss of light.

* General formulæ of calculation are given by M. Radau in the number of the *Moniteur Scientifique* for March 15th (Vol. vi. p. 259).

equal to half the principal refracting angle of the corrected prism, C. It is therefore evident that for spectroscopic purposes the principal refracting angle, C, of a direct vision prism *cannot be made less* than twice the "*critical angle*" of the glass employed in its construction (unless the glass be silvered) without involving a loss of light. The limiting form of such prisms has a nearly constant angle A equal to $15\frac{1}{2}°$, and an angle C varying from 67° to 90° for every kind of glass (see Figs. 3, 4). In Table I. the angle of *first internal reflection* is equal to the "*critical angle*" of the glass.

For spectroscopic purposes no advantage is gained by diminishing the angles C and A in the manner now supposed. The angles of incidence and emergence, as well as the original uncorrected deviation, and the dispersive power of the prism are all diminished at the same time. When on the contrary C is increased A increases, and with it the dispersion of the light. The angle of first internal reflection always remains equal to the semi-vertical angle of the prism, or equal to half C. When the latter angle, together with A, makes up 90 degrees the prism becomes isosceles, and the *second* internal reflection no longer takes place (see Fig. 5). A natural limit is therefore placed to the increase of the values of these angles, however desirable, and, therefore, to the dispersive power of the prism.

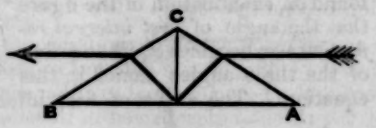


Fig. 5.

Long before the natural limit is reached the field of view becomes narrowed and contracted. Table II. exhibits the *greatest possible* angles

Table II.

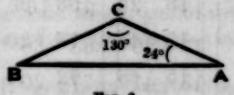
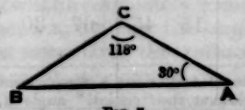
Index of refraction of the glass.	Greatest angle (A) of the prism.	Greatest angle (C) of the prism.	Extreme forms of prisms with greatest possible angles A and C.
1·4	24° 48′	130° 27′	
1·5	26 43	126 34	
1·6	28 17	123 26	
1·7	29 37	120 46	
1·8	30 43	118 34	

Fig. 6.

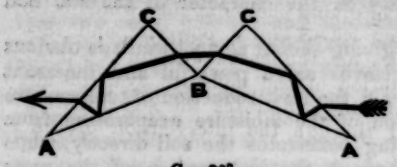
Fig. 7.

Scale of angles for a direct vision prism, in which the second internal reflection disappears. The angles A and C have the greatest possible values for double internal reflection.

which prisms for direct vision spectroscopes can have, and beyond which the second reflection disappears.

With a glass of high refractive power, as, for example, 1·66, the *right-angled prism*, and the compound spectroscope composed of *two such prisms* (Figs. 8, 9) holds a mean place between the extreme forms of the two preceding tables—the angle A in this prism being equal to 20° (between 15° and 30°), and the angle C is 90° (instead of 75° or 120°).

C = 90°
A = 20°
Fig. 8.



C = 90°
A = 20°
Fig. 9.

This form of prism is more simple of construction, and may be distinguished from the other more complicated forms by the name of the "*three-to-one* right-angled prism," because for common glass, the longest side is to the shortest side of the triangular section of the prism, in the ratio of very nearly three to one. The following are the values of the angle A in this prism, for every different kind of glass:—

Table III.

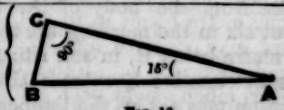
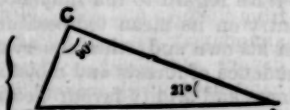
Index of refraction of the glass.	Angle A, for a 3:1 prism.	Angle C, of ditto.	Forms of 3:1 prism for different kinds of glass.
1·4	15° 0′	90° 0′	
1·5	16 52	90 0	
1·6	18 47	90 0	
1·7	20 25	90 0	
1·8	21 52	90 0	

Fig. 10.

Fig. 11.

Scale of angles for the three-to-one right-angled (direct-vision) prism for different kinds of glass.

THE INFLUENCE OF FORESTS ON CLIMATE.

M. BECQUEREL has recently brought this interesting question before the French Academy. The first portion of his paper gives details respecting the extent of forest land in France at various periods; the second discusses the climatic action of forests, and in it he states that their influence will be found to depend on their extent, the nature of the trees, whether having deciduous or permanent leaves, on the power of evaporation exerted by the leaves, and on their capacity of receiving or radiating heat, and lastly on the character of the soil and subsoil.

The effect of trees in giving shelter against winds is obvious and important. Their leaves are a powerful and incessant cause of moisture in the air, the least reduction of temperature occasioning a precipitation of the moisture evaporating from them, and which on falling penetrates the soil directly, when it is permeable, and through the intervention of the roots when it is not.

By means of the electric thermometer the temperature of trees has been observed for many years, and it appears that the trunk, branches, and leaves grow warm or cool in the air, as is the case with inorganic bodies; but in the north the mean temperature of trees is a little higher than that of the air. When tree trunks reach three or four centimetres in diameter they do not acquire their maximum temperature till after sunset. In summer this occurs about nine o'clock, while the air is warmest about two or three, according to the season. Variations in temperature take place very slowly in trees, and rapid changes of air temperature have no influence on them. When the leaves cool themselves by nocturnal radiation they retake from the body of the tree the heat which they lose. About six in the morning the temperature above a tree, and at one metre below it, in soil situated N. or S., is equal. Hence we may conceive how trees that have been warmed by solar radiation may act on the temperature of the air, and not lower it as much as has been supposed.

With regard to the influence of destroying the trees* of a country on its mean temperature, M. Boussaingault concluded from his own and other observations in tropical America, that abundance of forests and moisture tend to cool a climate, while dryness and aridity favour heating of the soil. On the other hand, Humboldt, discussing thermometrical observations made

* Our neighbours have the convenient word "*deboisement*," for which we want an equivalent. *Untreeing* might not be thought elegant, but would be intelligible. "Disforesting" would do, but it has a legal signification.

over an area of 40° long. in N. America, found that the mean temperature of a locality is not changed by the destruction of its forests. But though the mean temperature may be unaltered, the distribution of heat at given times may be affected so as to produce a modification of climate, and Humboldt considered that the destruction of trees ought to occasion an augmentation of mean temperature by removing several causes of cooling action.*

Up to the present time sufficient attention has not been paid to the influence of the soil exposed by tree destruction. The temperature of a soil varies according to whether it is dry or moist, calcareous, sandy, or clayey, and experiments show that two soils, one wet and the other dry, exposed to solar radiation, will differ 6° or 7° Cent. when the air temperature is 25° Cent. or 77° Fahr.; and for humus (vegetable mould) the difference will sometimes be as much as 12°. The physical character of the soil is likewise important; land covered with flints does not cool so fast as sand, and flinty soils are on this account found better for vines than chalky or clayey soils, which cool quicker. The destruction of trees in a region having a siliceous or silico-calcareous soil produces a maximum elevation of temperature. Thus, western Europe owes the mildness of its climate to warm currents which arrive from the deserts of Sahara, and if terrestrial changes should convert these deserts into forests, its climate would be more severe. In America we find the tropical regions occupied by vast forests, immense savannahs, and great rivers, which cannot produce hot air-currents like the Sahara desert, and soften the climate of the north. Thus, at equal latitudes, North America is colder than Europe, as we see from the direction of isothermal lines, and from its agriculture.

The influence of forests on the quantity of running water in a country is very important; but it is extremely difficult to say *à priori* whether the destruction of part of a forest will augment this or that spring or river. We only know the result after the forest has been cut down. Springs in general are due to infiltrations of rain water, which traverse the soil until they reach an impermeable layer, down which they run, if it be inclined, until they escape as streams or fountains. Such springs are usually found amongst mountains, but forests contribute equally to their formation, not only by means of the moisture which they produce and condense, but likewise on account of the obstacles they impose to evaporation from the soil, and by the action of their roots in rendering soils permeable.

* In connexion with these inquiries, Professor Tyndall's researches on the action of atmospheric humidity in arresting radiation should be considered.

Strabo tells us that it was necessary to take great care lest Babylon should be invaded by the waters. The Euphrates, he says, became swollen in spring, when the snows melted on the mountains of Armenia, overflowed its banks, and would have submerged the cultivated lands if the superabundant water had not been drawn off by canals like those of the Nile. This state of things no longer exists. M. Oppert, who travelled through Babylonia a few years ago, reports that the quantity of water transported by the Euphrates is much less than it was in former ages, that its banks do not overflow, that the canals are dry, and the marshes become so during the summer heats. The change, he assures us, has been produced by the destruction of forests on the mountains of Armenia. Choiseul Gouffier could not find the river Scamander in the Troad; although it was navigable in the days of Pliny, its bed is now dry, and the cedars are gone that once covered Mount Ida, from whence it arose.

M. Boussaingault informs us that the valley of Aragua, in the province of Venezuela, situated at a little distance from the coast, is closed on all sides. The rivers which run into it do not reach the sea, but give rise to the Lake of Tacarigua, which, according to Humboldt, experienced at the beginning of the century a gradual diminution, of which the cause was unknown. The village of Nueva Valencia, founded in 1585, was then only half a league from the lake, while in 1800 it was 2700 toises from it. In 1822, M. Boussaingault learnt from the inhabitants that the waters of the lake had risen, and that land formerly cultivated was then under water. For two and twenty years the valley had been the scene of sanguinary struggles during the war of independence, the population was decimated, the ground uncultivated, and forests, which grow with great rapidity in that climate, occupied a large portion of the soil. These are the principal facts which M. Becquerel brings into view.

GESTURE LANGUAGE AND WORD LANGUAGE.

"GESTURE language and word language" are the titles of some very interesting chapters in an important work by Mr. Edward Burnett Tylor,* who brings before the public a class of facts, not indeed new, but very little known, and not, we believe, previously placed in a philosophical light. "Gesture language"—how little does the term convey, except to the few who are acquainted with its remarkable character and development. All nations use gesture more or less, as a means of communicating their ideas. In infancy and childhood it forms a very important part of the signs by which feelings are made known and thoughts communicated; and while the adults of some races—like the English—acquire the habit of repressing and limiting its use under natural or conventional restraints, others—like the French and Italians—can scarcely recite a single fact, or express the commonest emotion, without an amount of gesticulation that indicates the real or supposed inefficiency of mere words to gratify their desire of communicating to others what they know or feel themselves. Nor does the quantity of gesture employed by civilized races afford any indication of the capacities of their various languages. The English, with a copious and remarkably rich language, use little action; while the Germans, with a similar language, admitting of a greater range of combination, use more gesture; and the Italians exceed the French, notwithstanding that the former have one of the richest and the latter the poorest language of the Latin stock. The infant expresses itself by gesture and inarticulate sounds. Infantile races have few articulate sounds and employ gesture, not as a mere adjunct to, but as an essential portion of their speech. Hence the question arises in the minds of those who believe that man has worked his way up from humble beginnings to his present stage of civilization, whether gesture language preceded word language in the order of development, and whether, after all, the ultimate and universal speech should not be sought in pantomimic action rather than in set forms of words.

It is not to be supposed that any race of people ever existed who did not make sounds the definite means of indicating objects or expressing thoughts; but until some progress is made in processes of inflection or agglutination, articulate sounds are the materials out of which a language may be compounded rather than language itself. Any one

* *Researches into the Early History of Mankind, and the Development of Civilization.* By Edward Burnett Tylor, Author of "Mexico and the Mexicans." Murray.

who has trained a dog, or used the services of a trained dog, understands the sounds he makes in reference to particular incidents and occasions, so that a particular bark or growl gives information which, within certain limits, is definite and precise. Analogous facts may be observed by resting quietly near a rookery, or at the base of cliffs where sea gulls build. It soon becomes obvious to the observer that the birds attach definite meanings to certain sounds, and thus, like the dogs, they are in possession of some elements of language; but we should not expect, if we were gifted with the faculty of thoroughly comprehending their speech, that we should detect any grammar in it, and find verbs to conjugate or nouns to decline. The civilized and educated dog acquires, from contact with man, ideas and thoughts that do not belong to the life of any wild animal. To a very considerable extent he learns human language, so far as it applied within his hearing to matters he can comprehend, and if he had the faculty of imitating it like a parrot or a jackdaw there can be no doubt he would use it to express his acquired ideas. What he really does is to improve his own voice language, and gesture language too, and there is a strongly marked difference between the power of expression professed by a well-bred, well-educated dog, and that which is at the disposal of another dog who is badly bred and uncultivated.

The capacity for forming a language is inseparably associated with the faculty of generating thought. We need not inquire whether man can think without any sort of language, of gesture, picture, or speech to assist his efforts; but no people have ever been discovered, and probably none could exist, who have arrived at complex processes of thought, including the power of abstraction and generalization, without possessing a language capable of signifying what they meant.

A very interesting branch of the inquiry into language relates to the modes of expression adopted by deaf-mutes, and Mr. Tylor points to the important distinction—generally overlooked by the public—between "the real deaf and dumb language of signs, in which objects and actions are expressed by pantomimic gestures, and the deaf and dumb finger alphabet, which is a mere substitute for alphabetical writing." Mr. Tylor cites the following authorities in order to show how deaf-mutes naturally talk. Samuel Heinicke, the founder of deaf and dumb teaching in Germany, remarks: "he (the deaf-mute) prefers keeping to his pantomime, which is simple and short, and comes to him fluently as a mother-tongue." Schmalz says: "not less comprehensible are many signs which we do not use in ordinary life, but which the deaf and dumb child uses, having no means of communicating with others but by signs.

These signs consist principally in drawing in the air the shape of the objects to be suggested to the mind, indicating their character, imitating the movement of the body in an action to be described, or the use of a thing or its origin, or any other of its notable peculiarities." "With regard to signs," says Dr. Scott of Exeter, "the deaf and dumb child will most likely have already fixed upon signs by which it means most of the objects given in the above lesson (pin, key, etc.), and which it uses in its intercourse with its friends. These signs had always better be retained by the child's family, and if a word has not received such a sign, endeavour to get the child to fix upon one. It will do this most probably better than you." The Abbé Sicard is quoted to a similar effect. He did not invent signs for his deaf and dumb pupil, of whom he said that by a happy exchange he taught him the mimic signs of his language, in return for the written signs of the French tongue. Kruse, a deaf-mute,* is also cited: "Thus the deaf and dumb must have a language, without which no thought can be brought to pass. But his nature soon comes to his help. What strikes him most, or what makes a distinction between one thing and another, such distinctive signs of objects are at once signs by which he knows these objects, and knows them again; they become tokens of things. And whilst he silently elaborates the signs he has found for single objects, that is, while he describes their forms for himself in the air, or imitates them in thought with hands, fingers, and gestures, he developes for himself suitable signs to represent ideas."

In the Deaf and Dumb Institution of Berlin, Mr. Tylor tells us that 5000 signs are stated to be employed—far exceeding the number of words used by the most ignorant classes in this country—and of these he took down about 500 of the most important. The sign for *I* is pushing the forefinger against the pit of the stomach; for *thou*, it is pushed towards the person addressed; for *he*, the thumb is pointed over the right shoulder. "When I hold my right hand flat, with the palm down, at the level of my waist, and raise it towards the level of my shoulder, that signifies *great*, but if I depress it instead, it means *little*." The motion of taking off the hat indicates a *man*, a *woman* is denoted by laying the closed hand upon the breast, and a *child* is signified by dandling the right elbow upon the left hand. "The adverb *hither*, and the verb *to come* have the same sign, beckoning with the finger towards oneself. To hold the first two fingers apart like the letter V, and dart the finger tips out from the eyes, is to *see*. To touch the ear and tongue with the fore-finger is to *hear*, and to *taste*. . . .

* Mr. Tylor speaks of him as "a teacher of deaf-mutes, and author of several works of no small ability."

The outline of the shape of roof and walls drawn in the air with two hands is a *house*; with a flat roof it is a *room*. To smell at a flower, and then with two hands make a horizontal circle before one, is a *garden*. To pull up a pinch of flesh from the back of one's hand is *flesh* or *meat*; make the steam curling up from it with the fore-finger, and it becomes *roast meat*. Make a bird's bill with two fingers in front of one's lips, and flap the arms, and that means *goose*; put the first sign and these together, and we have *roast goose*."

The gesture language has no inflections, and is so far like the Chinese, but it has a system which Mr. Tylor explains. He tells us that the deaf-mute arranges his words in a certain order without reference to the spoken language custom of the country to which he belongs. For black horse he says by his signs *horse black*; for bring a black hat, *black hat bring*; for I am hungry, give me bread, *hungry me bread give*. The general rule is that a deaf-mute begins with that which he thinks most important, "for instance, to say my father gave me an apple, he makes first the sign for *apple*, then for *father*, and lastly that for himself, dispensing with the verb."

There is no difficulty in perceiving that a good many ideas may be communicated by means of this gesture speech, but it is astonishing to what perfection it has been carried. Mr. Tylor cites from the *Justice of the Peace* for Oct. 1, 1864, a remarkable will, of considerable complication, dictated by a deaf-mute. He signified by gestures that he wished all his property to go to his wife at his decease, and that if she died during his daughter's lifetime, it was to pass to the daughter, and in the event of her death, to her husband, if he was the survivor; and if both died, then to their children. To make this last provision intelligible, he first repeated the signs for his son-in-law and daughter, and made other signs to signify their deaths. To indicate the children he placed his right hand a short distance from the ground, and raised it by degrees, and as if by steps, which were his usual signs for pointing out their children, and then a sweeping motion expressed the wish that all should come in.

Mr. Tylor informs us that, "in the Berlin Institution, the simple Lutheran service, a prayer, the gospel for the day, and a sermon, is acted every Sunday morning in the gesture language for the children in the school and the deaf and dumb inhabitants of the city, and it is a very remarkable sight. No one could see the parable of the man who left the ninety and nine sheep in the wilderness, and went after that which was lost, or of the woman who lost the one piece of silver, performed in expressive pantomime by a master in the art, without acknowledging that, for telling a simple story, and making comments

upon it, spoken language stands far behind acting. The spoken narration must lose the sudden anxiety of the shepherd when he counts his flock and finds a sheep wanting, his hurried penning up the rest, his running up hill and down dale, and spying backwards and forwards, his face lighting up when he catches sight of the missing sheep in the distance, his carrying it home in his arms, hugging it as he goes."

Passing from gesture language as in use amongst cultivated deaf-mutes, Mr. Tylor traces its employment by various wild tribes, who come into contact with each other, but who do not understand each other's spoken language, and shows how they have followed the same principles in devising appropriate signs as are in use in the Berlin Institution, or in other gatherings of deaf-mutes. He likewise refers to the gesture language employed by the Cistercian monks to mitigate their absurd rule of self-mortification, which interdicted speech except upon religious matters, and shows, by reference to a dictionary collated by Leibnitz, how closely their signs resemble those made by the deaf and dumb.

The question of the extent to which spoken languages bear traces of the same processes of thought and reasoning that are shown in the construction of gesture language, is a highly curious one, which, if carefully worked out, must have an ethnological as well as a philological value. Mr. Tylor supplies some very interesting reflections on this subject. He likewise enters into an inquiry concerning the existence of tribes who cannot communicate with each other by words only, but need to supplement their spoken language by that of signs. It is very difficult to ascertain such facts beyond a doubt. The use of gesture does not necessarily show that ideas could not be conveyed to other persons without it, but we think it highly probable that some savage tribes should possess more ideas than they have invented articulate sounds to express, and that when they have to be represented it must be in the gesture or pictorial form.

It must be remembered, that the deaf-mutes who have gone so far in the construction of a gesture speech, have done so under the constant stimulating influence of persons who know how to observe, to think, and to speak. In dealing with persons deficient in any one of the five senses, it is, as Mr. Bird, the blind surgeon, has so well shown in reference to those afflicted with loss of sight, essential to their development that they should come freely into contact with educated persons in a normal state. Left alone, the deaf-mutes would have had few signs, because they would have had little knowledge and few ideas. By showing them objects they would not have noticed of their own accord, and imparting ideas

they could not have possessed without external aid, a necessity has been created for them to extend their gesture language; and we can only expect to find such a language highly developed under circumstances that favour an amount of intellectual development considerably above that of the lowest races of mankind, and which also render spoken language impossible, as in the case of deaf-mutes; or inapplicable, as where American Indians are in the habit of meeting with tribes whose language they do not know, and have no facilities for acquiring.

Thus, though gesture language may stand in order of development before articulate speech, it could only reach its point of culmination long after articulate spoken language had made considerable advances.

THE ROMAN POTTERIES AT DUROBRIVÆ.

BY THOMAS WRIGHT, F.S.A.

(With a Coloured Plate.)

In the flat low district, where the river Nen forms the boundary line between the counties of Huntingdon and Northampton, are found two adjacent parishes and villages, one on the Northamptonshire side of the river, called Castor, the other, on the Huntingdon side, known by the name of Chesterton. Castor is distant about four miles and a-half west from Peterborough. Both these names furnish, combined with its position on one of the most imposing of the Roman lines of road, the Ermyn Street, undeniable evidence that this locality has been the site of a Roman settlement of some importance; and accordingly, accidental discoveries first, and afterwards excavations carefully planned and executed, brought to light the remains of a town of some extent, which, to judge by the foundations, and by the occurrence of tesselated pavements, must have consisted of large and handsome houses. But that which gave still greater interest to this place was, that it was found to have been once a great establishment of potteries—a sort of Staffordshire of Roman Britain; and not only was abundance of the pottery made here found scattered about, but the kilns themselves in which it was baked. It was the first well-ascertained discovery of manufactories of Roman pottery in this island. A comparison of the local circumstances with the ancient itineraries has enabled us to identify this place with the town which stands, in the itinerary of Antoninus, between

Roman Pottery from Durobrivæ.

Durolipons, which is represented by the modern Godmanchester, and Causennæ or Ancaster, and which there figures under the name of Durobrivæ.

The man to whom we owe this discovery was Edmund Tyrrell Artis, who resided on the spot as agent of the Duke of Bedford, the modern lord of the soil. Mr. Artis was an intelligent, but a self-educated man, and, unfortunately, after publishing figures of the more interesting objects found in the course of the excavations, in a very handsome folio volume of plates,* he was never able to write the volume of descriptive text intended to accompany it; and what he had learnt on the subject has only been partly communicated to the public, in two or three casual articles, from the pen of his friend, Mr. Charles Roach Smith.† Mr. Artis calculated that he had found the remains of the kilns spread over a space of not less than twenty square miles, so that no doubt can be entertained of the great extent to which this manufacture was carried at Durobrivæ. By this discovery we first became acquainted with certain kinds of pottery which were undoubtedly manufactured in Britain under the Romans, and, as no traces of the manufacture of the same ware have been met with on the Continent, and examples of it found there are not numerous, and may therefore have been exported from Britain, we seem justified in considering it as peculiar to this island. The discovery of so many of the kilns, some of them nearly perfect, discloses to us, moreover, the manner in which it was made. Mr. Artis investigated this part of the subject with great practical intelligence.

There are some varieties of this Durobrivian ware, and two especially have been remarked; the first blue or slate-coloured, the other reddish-brown or of a dark copper colour. The latter was coloured by a simple though curious process, which Mr. Artis was enabled to investigate in a very satisfactory manner. It will, perhaps, be best told in his own words. "During an examination of the pigments used by the Roman potters of this place," he says, "I was led to the conclusion that the blue and slate-coloured vessels met with here in such abundance, were coloured by suffocating the fire of the kiln, at the time when its contents had acquired a degree of heat sufficient to ensure uniformity of colour. I had so firmly made up my mind upon the process of manufacturing and firing this peculiar kind of earthenware, that for some time previous to the recent discovery [in 1844] I had denominated the kilns in which it had been fired *smother kilns*. The mode

* *The Durobrivæ of Antoninus Identified and Illustrated*, large folio, 1828.

† These will be found in the *Journal of the British Archæological Association*, vol. i. p. 1; in Smith's *Collectanea Antiqua*, vol. iv. p. 80, etc.

of manufacturing the bricks of which these kilns are made is worthy of notice. The clay was previously mixed with about one-third of rye in the chaff, which, being consumed by the fire, left cavities in the room of the grains. This might have been intended to modify expansion and contraction, as well as to assist the gradual distribution of the colouring vapour. The mouth of the furnace and top of the kiln were, no doubt, stopped; thus we find every part of the kiln, from the inside wall to the earth on the outside, and every part of the clay wrappers of the dome, penetrated with the colouring exhalation. As further proof that the colouring of the ware was imparted by firing, I collected the clays of the neighbourhood, including specimens from the immediate vicinity of the smother kilns. In colour some of these clays resembled the ware after firing, and some were darker. I submitted them to a process similar to that I have described. The clays dug near the kilns whitened in firing, probably from being bituminous. I also put some fragments of the blue pottery into the kiln; they came out precisely of the same colour as the clay fired with them, which had been taken from the side of the kilns. The experiment proved to me that the colour could not be attributed to any metallic oxide, either existing in the clay or applied externally; and this conclusion is confirmed by the appearance of the clay wrappers of the dome of the kiln. It should be remarked, that this colour is so volatile that it is expelled by a second firing in an open kiln." Mr. Artis proceeds to inform us that these kilns, so many of which were discovered, were "all constructed on the same principle. A circular hole was dug, from three to four feet deep, and four in diameter, and walled round to the height of two feet. A furnace, one-third of the diameter of the kiln in length, communicates with the side. In the centre of the circle so formed was an oval pedestal, the height of the sides, with the end pointing to the furnace mouth. Upon this pedestal and side-wall the floor of the kiln rests. It is formed of perforated angular bricks, meeting at one point in the centre. The furnace with bricks moulded for the purpose. The side of the kiln is constructed with curved bricks, set edgeways in a thick *slip* (the same material made into a thin mortar) of the same material, to the height of two feet." Fortunately, some of these kilns remained almost entire, and many had been left with the pottery partly packed in them for firing, so that there was no difficulty in understanding the nature of the process here employed by the Roman potters. Mr. Artis goes on to say, "I now proceed to describe the process of packing the kiln, and securing uniform heat in firing the ware, which was the same in the two different kinds of kilns. They were

first carefully loose-packed with the articles to be fired up to the height of the side walls. The circumference of the bulk was then gradually diminished, and finished in the shape of a dome. As this arrangement progressed, an attendant seems to have followed the packer and thinly covered a layer of pots with coarse hay or grass. He then took some thin clay, the size of his hand, and laid it flat on the grass upon the vessels; he then placed more grass on the edge of the clay just laid on, and then more clay, and so on until he had completed the circle. By this time the packer would have raised another tier of pots, the plasterer following as before, hanging the grass over the top edge of the last layer of plasters, until he had reached the top, in which a small aperture was left, and the clay nipt round the edge; another coating would be laid on as before described. Gravel or loam was then thrown up against the side wall, where the clay wrappers were commenced, probably to secure the bricks and the clay coating. The kiln was then fired with wood. In consequence of the care taken to place grass between the edges of the wrappers, they could be unpacked in the same size pieces as when laid on in a plastic state, and thus the danger in breaking the crust to obtain the contents of the kiln could be obviated."*

This Durobrivian pottery has an especial interest for us, because it is covered with ornaments and figures, raised in relief like those on the Samian ware, but not like it cast from moulds. "The vessels," Mr. Artis remarks, "after being thrown upon the wheel, would be allowed to become somewhat firm, but only sufficiently so for the purpose of the lathe. In the indented ware, the indenting would have to be performed with the vessel in as pliable a state as it could be taken from the lathe." The ornamenter then took a slip of rather liquid material, and with an implement made for the purpose, formed all the ornaments and figures with the hand. The slip used for this purpose was often white, which was laid on a dark ground. "The vessels, on which are displayed a variety of hunting subjects, representations of fishes, scrolls, and human figures, were all glazed after the figures were laid on; where, however, the decorations are white, the vessels were glazed before the ornaments were added. Ornamenting with figures of animals was effected by means of sharp and blunt skewery instruments, and a slip of suitable consistency. These instruments seem to have been of two kinds: one thick enough to carry sufficient slip for the nose, neck, body, and front thigh; the other of a more delicate kind, for a thinner slip for the tongue, lower jaws, eye, fore and hind legs, and tail. There

* *Journal of the British Archæological Association*, vol. i. pp. 3—5.

seems to have been no retouching after the slip trailed from the instrument."

Of the forms of mere ornamentation of this ware, the scroll ornaments appear to have been the most popular, probably because it was the one most easily executed with freedom by the process just described. The arrangement and combination of the scrolls, which are sufficiently varied, are often both tasteful and very effective. In our cut, Fig. 1, I

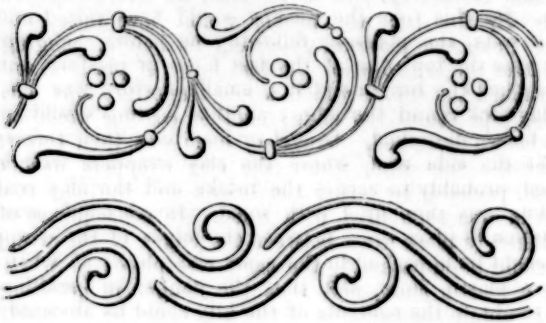


Fig. 1.—Scroll Ornaments taken from Durobrivian Pottery.

have selected two examples, from among those given in Mr. Artis's plates; and others are furnished by the two examples of the slate-coloured ware, also taken from Artis, which form the centre figure and the lower figure to the right of our coloured plate. These, it may be remarked, are examples of the most common forms and shades of colours of the Durobrivian pottery.

It is, however, the figured Pottery of Durobrivæ, which presents some of the characteristics of the Samian ware, that possesses the greatest interest for the antiquary and the historian. The variety of subjects in the Samian ware is far greater, and they are treated in a more elaborate and more highly finished style of art, yet similar classes of subjects appear to have enjoyed greater popularity than others in the Durobrivian and Samian pottery, and we can hardly help suspecting that there was some design of imitating, or perhaps a sentiment of rivalry. Considering that they were only executed with the hand, and it would appear rapidly, the style of drawing is remarkably good and spirited, and, as Mr. Artis has remarked, the courage and energy of the hounds, and the distress of the hunted animals, are expressed with great skill and fidelity. But they have another and a peculiar value; when we consider that they were certainly executed in this

country, and by artists who could hardly have done otherwise than copy what was constantly before their eyes, we can have no doubt that these are all true pictures, pictures which we could hardly in any other way have obtained, of life in Britain under the Romans, and they show us, as well as could be shown in subjects capable of being represented by such artists, those occupations in which the enjoyment of life was then believed to consist. The more common of these subjects are hunting scenes, and scenes taken from the amphitheatre or the racecourse.

We have abundant evidence, in a great variety of monuments of different classes, of the love of the people of Roman Britain for the pleasures and excitement of the chase. It is sufficiently well known how, among the bones of animals which had been eaten at the table, which are found on Roman sites in England and Scotland, a large proportion testify to the presence in great abundance of the wild boar, of the wild deer (of several varieties), and of almost every animal which comes under the name of game. Britain, too, was celebrated for its dogs, and it would not, I imagine, be impossible for the comparative anatomist to reproduce the forms of the varieties of the dog known here during the Roman period from these figures on the pottery compared with bones of the dog still found among Roman remains. The Roman writers speak not unfrequently of the excellence of the British dogs, especially of the dogs for hunting, and they seem to have formed a rather important article of export. In the figures on the Durobrivian pottery, the dogs are pictured, and evidently with truthfulness, with distinct characteristics of different varieties. For instance, the dog hunting the hare in our cut (Fig. 2),

Fig. 2.—Hunting the Hare.

taken from an example of Durobrivian ware engraved in Artis's plates, must be recognized at once as a greyhound, the same variety of dog which is still used for the same purpose. It has been suggested that this may be the dog to which the Romans gave the name of *vertagus*, and which is said to have been a British dog. Martial describes it in one of his epigrams as

hunting the hare spontaneously and alone, and bring it, when killed, home carefully to its master, without damage to the body—

"Non sibi, sed domino, venatur vertagus acer,
Illæsum leporem qui tibi dente feret."

It is certain that the Romans valued especially the hunting dogs which they obtained from Britain. Oppian (*Cyneg.* i., 468) calls them a noble race, speaks of them as slender in form, and commemorates their other characteristics, in terms some of which might apply to the greyhound—

"Εστι δέ τι σκυλάκων γένος ἄλκιμον ἰχνευτήρων,
Βαιὸν, ἀτὰρ μεγάλης ἀντάξιον ἴμμεν' ἀοιδῆς·
Τοὺς τρᾶφεν ἄγρια φῦλα Βρεταν῀ων αἰολονώτων."

The Roman writers have not left us any very satisfactory description of the varieties of the dog, as they existed among them, and they were probably far less numerous than at present. The ancient writers, even those who treat especially on cynegetics, speak in general terms of this domestic animal, and of his faithfulness and intelligence, but say less about the special qualities of its different varieties. Nemesianus, another poet who wrote on this subject, tells us, without any particular description of them, of different breeds of dogs which came from different countries, and expressly states that those brought from Britain were remarkable for their swiftness, and for their excellence for hunting.

"Divisa Britannia mittit
Veloces, nostrique orbis venatibus aptos."
Nemesiani *Cynegetica*, l. 123.

Fig. 3.—A Stag-hunt.

This description accords with the greater number of the figures of dogs represented in the hunting scenes of our Durobrivian

pottery. Our cut, No. 3, taken from a sample of this pottery given in one of Mr. Artis's plates, no doubt represents the British staghound of the Roman period. Though not dissimilar in shape, it appears to be of a stronger and larger make than the greyhound represented in the former cut. The draughtsman here appears to have intended to distinguish two varieties of the stag, in the different forms he has given to their antlers. We have a different dog in other examples, as in the group given in our next cut (Fig. 4), where a dog of apparently a much fiercer character (see our cut, Fig. 4, which is taken from a very remarkable vessel of this Durobrivian ware, now known as the Colchester Vase), appears driving before him both stags and hares. The hunting of the boar is also introduced in some examples of this pottery.

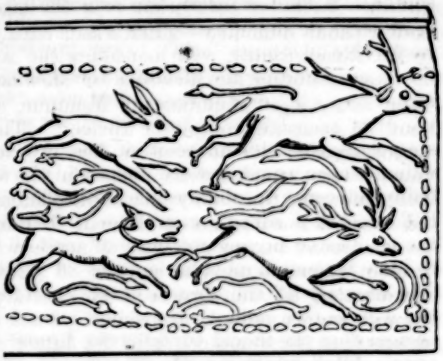


Fig. 4.—Hunting the Stag.

Gladiatorial combats are also favourite subjects on the pottery made at Durobrivæ, as on the Samian ware, and they leave no doubt that these cruel and degrading exhibitions were cherished by the Romans in Britain as well as in Italy. We have singular evidence of the prevalence of the taste for such shows in the figures on the Colchester vase. This very remarkable monument of the ceramic art in Roman Britain, which is represented, of course, on a very diminished scale in the first figure of our coloured plate, was found, in 1853, in the Roman cemetery which occupied the site of West Lodge, near Colchester. It had been used as a sepulchral urn, and, when found, contained calcined bones, and was covered with an inverted shallow vessel or dish. It may be right to state that this interesting vase is nine inches in height by six in diameter. The ornamentations consist of three groups, one of which is the flight of stags and hares pursued by a dog given in our cut (Fig. 4). The second and, perhaps we may say, the principal group represents the combat of gladiators, which appears in our engraving of the vase. It represents, in perfectly correct drawings, the two classes of gladiators, a *Secutor* and a *Retiarius*, the latter of whom, vanquished, has dropped his

trident, and raises his hand to implore the mercy of the spectators. The Secutor, with a close helmet over his head, and a short sword in his hand, advances to strike the fatal blow, unless arrested by the success of his adversary's appeal. Over the head of the Retiarius is the inscription, VALENTINV LEGIONIS XXX., meaning clearly, "Valentinus, of the thirtieth legion," which was doubtless the name of the individual here represented. A similar inscription over the head of the Secutor is read without difficulty—MEMN.N.SAC. VIIII., which is explained by Mr. Roach Smith, who considers the A in SAC as an error for E, as standing for *Memnius* (or *Memnon*) *numeri secutorum victor ter, i. e.*, "Memnius, or Memnon, of the numerus (or band) of secutors, conqueror thrice." There is no reason for supposing that this inscription has any reference to the individual whose remains were buried in the vase, but it has probably reference to some remarkable gladiatorial combat which had created a sensation in Roman Britain, like some one of the celebrated boxing matches of modern times, sufficiently so to have become a popular subject of pictorial representation. The drawing of the figures is so carefully minute that even the well-known nails of the shoes are not forgotten, and it is curious that the shield contains the figure called in the middle ages a filfot, which, as Mr. Smith remarks, is often found on the monuments of the Ælian Dacians, whose quarters were at Amboglanna, on the wall of Hadrian. Possibly Memnius may have been one of them.*

The third group on the Colchester vase also represents a performance which was very popular among the Romans and among the Saxons, and indeed throughout the Middle Ages, that of a bear-tamer and disciplined bear. The bear, in this case, appears inclined to be rebellious, and his keeper, whose left arm bears what appears to be a shield, and his legs and right arm protected by bands or thongs, is menacing the animal with a whip. An assistant is approaching with what appear to be two staves in his hands, for the purpose also of intimidating the ferocious animal. Over the head of the man holding the whip are the letters SECVNDVS MARIO, the intended application of which is not very clear. It has been suggested that it may mean simply that the cup was a gift from Secundus to Marius; or it may be that the bear was a pet animal, to which the name of Marius may have been given, and Marius and his master, or controller, Secundinus, may have had a momentary fame like that of Banks and his horse Morocco in the times of our James I. At all events, this remarkable vase shows what curious information relating to the condition and history

* See Mr. Roach Smith's interesting account of this vase in the *Collectanea Antiqua*, vol. iv., pp. 82—89.

of Roman Britain may be obtained from the collection and study of the figures on the pottery made at Durobrivæ.

The upper figure to the right in our plate represents a vessel in Durobrivian ware, which is preserved in the room of British Antiquities in the British Museum. The figures upon it represent a chariot-race in the Roman racecourse or stadium, the traces of several of which have been met with in the neighbourhood of our greater Roman stations. The chariot, or quadriga, has the classical form, rather rudely designed, and is drawn by four horses abreast. Other vessels of this pottery were ornamented with encounters and combats between men and men, or between men and animals. One fragment, as far as we can judge from the portion of the animal which is left, represented a man fighting a wolf, an animal then no doubt common in the forests of Britain. Sometimes the ornamentation consists of mere groups of animals, or of fishes, especially the dolphin. Birds, which were perhaps more difficult to form with the potter's slip, are less frequent.

But I will not attempt here to give anything like a list of the various subjects represented on the Durobrivian pottery, but will only allude to another class of subjects of extreme interest as coming from a Romano-British pottery. These are mythological subjects, which it must be confessed are not very common, as they are on the foreign Samian ware, but they all belong to the purely Roman mythology. A combination of deities which appears to have been most popular in the western provinces of the Roman empire was that of the gods who presided over the days of the week, which, under the Romans, commenced with Saturday (*dies Saturni*), and these gods were arranged in the following order: Saturn, Sol (or Apollo), Luna (or Diana), Mars, Mercury, Jupiter, and Venus. Works of art of the Roman period representing these divinities are found not uncommonly in Gaul, Germany, and Britain, and they appear to have been rather a favourite ornament of the Durobrivian pottery.* Fragments of several vessels with the figures of the seven gods and goddesses have been met with, from some of which Mr. Fairholt has restored the example which forms the lower figure on the left-hand side of our plate. This vessel presents also another characteristic of the Durobrivian ware, more especially employed in urns of this form. It consists of indentations made in the side of the vessel, while still soft, but after it had left the lathe, and continued with regularity round it. Sometimes, where little ornament was employed on the rest of the vase, these indentations were left quite plain; sometimes an ornament was introduced in the

* See my book, *The Celt, the Roman, and the Saxon*, Second Edition, pp. 269 to 271.

centre; and not unfrequently the indentation was formed into a niche for the reception of a figure. This is the case with the example before us, which is surrounded with ornamental niches containing the figures of those deities who gave their names to the days of the week. The one is recognized immediately as Jupiter brandishing his thunderbolt; the other appears to be intended to represent Mars. It is, perhaps, by a mere and accidental error of the potter's artist that Mars, in this instance, occupies the place of Mercury. Two other fragments of the same vessel contain the lower parts of the figures of Mercury, with his caduceus, and Diana. Perhaps these vases with mythological subjects were considered to possess more importance than the others, for they present peculiarities of colour. A fragment, containing a figure of Minerva, rather rudely executed, is straw colour, with a buff glaze. The most curious of these fragments contained part of the scene representing the mythic story of Hercules and Hesione. The figure of the sea-monster only is lost by the fracture. Hercules, with the lion's skin wrapped round his left arm, brandishes his club in the act of attacking the monster. Hesione stands naked between her deliverer and her persecutor, having apparently her hands fettered behind her, with heavy weights hanging by chains from her arms.*

It seems probable that these potteries at Durobrivæ do not belong to a very early period of the Roman occupation of the island. The style of art, and their general character, perhaps indicate a period not older than the latter part of the second century, and we cannot help thinking that the peculiar style of ornamentation originated in the desire to furnish a home-made substitute for the imported and, therefore, we must suppose, expensive Samian ware. As I have already remarked, this pottery forms one of the most curious and instructive monuments of the history of the internal condition of our island during the Roman period. Its character is entirely Roman, and in the mass of its remains, which has down to the present moment been examined, we find not the slightest trace of Celtic or Germanic sentiment.

* These fragments, which were collected by Mr. Artis, are engraved and described in Mr. Roach Smith's *Collectanea Antiqua*, vol. iv., pp. 90—93.

COLOURS OF STARS.—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

EVERY inquiry relating to stellar light possesses additional interest since the extraordinary success which has attended the investigations of Mr. Huggins. Now that he has shown the possibility of a greater approximation than could have been anticipated, to a knowledge of the constitution of these distant suns, each additional fact concerning their aspect acquires a relative value which it did not previously possess. A great step has been taken, when in the prosecution of an inquiry we have fixed a central fact to which others may be referred—a nucleus, as it were, round which our floating information may become crystallized, and settle into a definite form. Such has been the discovery of metallic and gaseous bands in the spectra of the stars. And it now becomes desirable that future researches into stellar light, whether as to its variableness in intensity or in colour, should be conducted with reference to this primary determination. A new and beautiful line of inquiry has thus been unexpectedly opened for amateurs possessed of instruments of sufficient light; and it is one which, it is to be hoped, will be carried on with the more spirit and enterprise, since it has been, as it were, committed to their care by the Astronomer Royal. The great Equatorial at Greenwich, with its 12¾ inches* of aperture, will not, it appears, be employed in these investigations, Mr. Airy having made known his opinion,† that the scrutiny of the sun's surface and the observations of star-spectra have now been taken up so well by amateur observers, that it appears to him just to leave these subjects in great measure to the private persons who have given to them such laudable attention. Mr. Huggins's extraordinary success, with considerably less than half the light, fully proves that so large an aperture is not requisite, and Mr. Browning's indefatigable exertions in perfecting the spectroscope will, we may hope, be rewarded by its more frequent employment. We must not suppose, however, that the extension of Mr. Huggins's great discovery will be found an easy undertaking. There may be little difficulty, with a sufficient aperture and well-adjusted spectroscope, in perceiving the bands already recognized, but it would be found quite another matter to follow his steps, and those of Dr.

* Such, I am informed (that is, 12 Paris inches) is its real measure, notwithstanding my supposed correction of an imaginary mistake in INT. OBS., v. 55, note.

† *Report of the Astronomer Royal*, 1865, p. 11.

Miller, in identifying them by patient and laborious measurement. As Admiral Smyth has said, in his recent interesting treatise on *Sidereal Chromatics*, "it is only on the finest nights that the lines in the stellar spectra are steady enough for measurement. Indeed, the difficulties of observation are now so complex, that the *complete* scrutiny of the spectrum of a single star may probably be the work of some years."

Fortunately, however, for those interested in these delightful studies, a subordinate, but very useful branch of the same inquiry is open to the possessors of even moderate optical means, who may do essential service by collecting data, to be used as materials in its future prosecution. We are not now referring to the phenomena of variable light, though these well merit a close scrutiny, but to those of changes of colour. This curious subject has been repeatedly brought before our readers, and we may refer them especially to a paper at page 436 of Vol. v., as enumerating some of the cautions necessary in the study of it.* But the additional interest which, as we have said, it has received from recent discoveries, induces us to revert to it; especially as the beautiful pair 95 *Herculis* described in that paper is now coming into a convenient position again. Since that time, some further remarks on these stars have appeared in the *Sidereal Chromatics* of Admiral Smyth, from the late deeply-regretted Captain Higgens, of Bedford. Thirty-eight observations between May 21 and August 8, 1864, led him to the inference that the colours were less vivid than in the previous September, and that A (the green star) showed more loss of colour than B (the red), "though neither to the extent of justifying their being classed as anything but normal, though somewhat faintish." Professor Piazzi Smyth, however, from an extended comparison of the observations of W. Struve, Admiral Smyth, Sestini, Fletcher, Wrottesley, and himself, including a series of years from 1828·71 to 1862·72, has come to the more decided conclusion that A passes through the successive tints of yellow, greyish, yellowish with blue tinge, greenish, light green, light apple green, "astonishing yellow green," and yellow again, in a period of probably twelve years, while B in the same time passes from yellow, through greyish, yellowish with reddish tinge, reddish, cherry red, "egregious red," to yellow again. Should this deduction be confirmed by testimony so extensive and accumulated as to

* Further consideration and experience have led to the conclusion that the superiority of silvered specula in such inquiries was there somewhat overrated. Since brilliant objects seen through the imperfectly transparent film acquire a blue tint, the reflected rays from which this has been abstracted cannot be perfectly white, but must be very slightly tinged with the complementary orange. The great advantage, however, of the absence of any outstanding fringe remains.

eliminate that most annoying element of uncertainty, "personal chromatic equation," and establish the alleged periodicity, here will be a truly important field for spectrum analysis. But though, in the present state of our knowledge, the Professor is fully justified in calling this "one of the most remarkable cases in the heavens," we cannot say, considering the recent date of the inquiry, that instances yet more decided may not yet remain to be disclosed.

If such phenomena attain the rank of established facts, there would seem no other way of accounting for them but by supposing that a change takes place in either—1, The composition or temperature of the luminous material, or—2, The condition of an encompassing atmosphere, or—3, The accidental interposition of unknown media in intervening space. The latter hypothesis, however, which has been suggested by Sir J. Herschel in the case of *Sirius*, is of course excluded in periodic variations; and the proof of any one such instance would go far to displace it altogether. The two previous suppositions would come strictly within the range of spectrum analysis. It is much to be regretted that with the exception of *Arcturus*, whose change of colour is very questionable, all the suspected objects are possessed of an inferior degree of light; and a material difficulty is thus introduced in the use of the spectroscope; but if this could be overcome, and if a clear instance of change could be brought under examination, it would be most interesting to ascertain whether any corresponding effect was produced upon the dark bands; and either an affirmative or a negative result would advance our knowledge of the composition of light. In the absence of any conspicuous instance, what we have now to do is to endeavour to lay so firm a hold upon less obvious phenomena as to place them beyond the reach of suspicion; and to exercise our ingenuity in devising the best means of so grappling with them. The beautifully executed diagram of tinted discs in the *Sidereal Chromatics*, will give very valuable help in training the eye to the discrimination of colour, though the plan certainly involves, as has been suggested, some use of "qualifying adjectives," since the colours of stars are frequently incapable of being referred to tints of such a simple character. Other modes of experimenting yet remain, and ought to be tried if possible.

It follows from the comparisons of Professor P. Smyth at Teneriffe, that in our latitudes no determination of colour can be strictly relied upon beyond 10° of S. Decl.; but this leaves abundant room for the inquiry; and with a view of saving trouble to those who may be disposed to enter upon it, the following suspicious instances have been selected from our

Double Star List, to which many might be added from other sources:—

δ Herculis	(No. 25,	Int. Obs.,	ii. 55.)
12 Canum	(No. 29,	,,	ii. 56.)
44 Boötis	(No. 33,	,,	ii. 133.)
σ Coronæ	(No. 37,	,,	ii. 134.)
95 Herculis	(No. 40,	,,	ii. 136.)
$\epsilon^1$4 Lyræ	(No. 47,	,,	ii. 301.)
η Lyræ	(No. 51,	,,	ii. 303.)
μ Cygni	(No. 62,	,,	ii. 373.)
γ Delphini	(No. 63,	,,	ii. 373.)
a Piscium	(No. 80,	,,	iii. 55.)
γ Leonis	(No. 104,	,,	iii. 219.)

The following observations of some of these stars with a 5½-inch object-glass may be added as the result of the present season: common epoch 1865·45.

δ Herculis. Pale lemon yellow and lilac, by a perfectly independent judgment. The *comes* exhibited the curious phenomenon of oscillation (see Int. Obs. ii. 375) in a remarkable degree. With a power of nearly 450, and an unsteadied telescope, the vibrations were extraordinary.

12 Canum. Pale yellow and fawn colour.

44 Boötis. On a general view, both pale yellow; yet with some not very definable difference: when more closely studied B sometimes seemed inclining to bluish, but on the whole I believe it was tawny. This was my first observation of the pair with my present achromatic, and the result a perfectly independent one.

95 Herculis. Apple green and light orange: very clearly marked.

OCCULTATIONS.

July 3rd.—8 Libræ, 6 mag., 9h. 45m. to 10h. 48m.—a^3 Libræ, 2½ mag., 9h. 58m. to 10h. 52m.—8th, ρ Sagittarii, 4 mag., 9h. 21m. to 10h. 11m. The double occultation on the 3rd will be a very interesting phenomenon, especially as one of the stars is so large, and forms one of the members of an optical pair, Number 10 of our Double Star List (Int. Obs., i. 375).

ARCHÆOLOGIA.

THE church of BOSHAM, near Chichester, has recently been the subject of a number of paragraphs in the newspapers, on account of rather extensive restorations which are being carried on in it. Bosham is a place well known in history. It was a manor belonging to Earl Harold, the son of Godwin, who afterwards became the last of the Anglo-Saxon kings of England, and it was from hence that he sailed for Normandy, on that eventful journey in which he was entrapped into a fatal acknowledgment of the claims of Duke William to the succession of the Anglo-Saxon crown. The locality was connected with Anglo-Saxon history by other circumstances belonging to still earlier dates. It had a small monastic establishment as early as the latter half of the seventh century, when Wilfred began here the conversion of the South Saxons to Christianity. One of the daughters of King Cnut is said to have been buried in the church of this monastery, and he is supposed to have been so closely connected with it that some writers have conjectured it to have been the scene of that beautiful scene of the Anglo-Danish monarch attempting in vain to dictate to the tides of the ocean. But there are reasons for supposing that, if the story have any foundation in truth, its scene was not the sea shore, but the banks of the river Thames, at Westminster, where the later kings of Anglo-Saxon England had their palace, and that King Cnut merely went out of his palace to rebuke the flattery of his courtiers by showing them his inability even to check the advance of the tide in the river. The church of Bosham has recently been restored, and the course of the work has brought to light many portions of the original Anglo-Saxon masonry which were not previously known to exist. As many Roman tiles had been used in the building, it is probable that the church, which must have been one larger than it is at present, was raised on or near the site of a Roman establishment of some kind or other. In this older building one of the distinguishing characteristics of the Anglo-Saxon masonry, the "long-and-short work of the angles, is found in abundance, as well as some herring-bone work. Silver coins of the reign of Edward I., with an old knife, were found in the drain of an early *piscina*.

The lead mine on SHELVE HILL, in Shropshire, known as the Roman Gravels Mine, is remarkable for its bold remains of the mining operations of the Romans on this site, which have been described in a former volume of the INTELLECTUAL OBSERVER (see Vol. i. p. 295). The modern mine is now worked by a company with great success, especially since they have reached a depth beyond the extent of the Roman workings. In their progress they continually fall in with the shafts and galleries in which the Roman miners had worked, and they found in them a few objects which those ancient miners had left behind them. Some only of these have been preserved, and are now in the possession of the lord of the land, Mr. More, at Linley Hall. They consist of spades, formed by splitting very sound oaken timber, and of MINERS' CANDLES. The latter are

extremely curious, and have not been noticed till recently. The wicks are formed of hemp, and they have been made by dipping, but length of time has turned the tallow into a substance which is almost as hard and brittle as marble. It has been asserted that the ancients were not acquainted with the use of candles, and that their only method of giving light was by means of lamps supplied with oil, but these candles of the Roman miners appear to overthrow entirely this theory. And indeed, as we know that the Anglo-Saxons used candles, and from them we derive the modern use of them, and as the Anglo-Saxon *condel* or *candel* was undoubtedly derived from the Latin *candela*, there is every reason for believing that our forefathers derived the use of candles from the Romans as well as the name.

A large sepulchral TUMULUS has been opened on LANGTON WOLD, in the East Riding of Yorkshire, under the direction of the Rev. W. Greenwell of Durham. It is situated hardly more than two miles from Old Malton, which has every claim to be considered as the *Derwentio* of the Romans. It is a large tumulus, though low, which is rather a characteristic of the East Yorkshire tumuli, and is not, we think, a characteristic of an early date. The first openings, according to the accounts published, brought to light undoubted Anglo-Saxon interments, with fragments of, as we understand, cinerary ware, indicating the mode of interment which appears to have prevailed among the Anglo tribes who settled in this island. In the centre was found a rude chamber, in which a skeleton was found laid on its left side, which is certainly not, as appears to be assumed, a proof of its being an early British interment, for we have ourselves found in East Yorkshire undoubted Anglo-Saxon interments, in which the body was placed in this position, and in some cases doubled up. We are only speaking from a newspaper report, and are, therefore, unwilling to speak too decidedly, but this report does not lead us at all to think with it that the supposed non-Anglo-Saxon interments belong to a *very early* British period, and that there were at least 2000 years between the dates of the two different interments. It is contrary to the notions which history gives us on such a subject. We have no doubt that the Anglo-Saxons mixed freely enough with the Roman population they found here, and we find sufficient proofs of their burying their dead in the same cemeteries; but it is not merely improbable that an Anglo-Saxon would open the grave of a people so utterly unknown to him as the prehistoric Britons to bury a kinsman in it. We are inclined to believe, as the result of many researches and investigations, that there was a period between the perfectly Roman and the perfectly Anglo-Saxon to which a large proportion of the tumuli which are commonly called British belong; but we abstain from further remarks on this case, until the publication of the promised report of these excavations by the gentleman who has directed them. T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

ROYAL SOCIETY.—*May* 4.

On the Properties of Liquefied Hydrochloric Acid Gas.—Professor Stokes communicated a most important paper, by Mr. G. Gore, on the properties of hydrochloric acid gas liquefied under great pressure. The liquid is a very feeble conductor of electricity, and has but a very limited solvent power for solids. Of five metalloids submitted to it only one was dissolved, namely, iodine; of fifteen metals placed in it only one, aluminium, was dissolved; of twenty-two oxides it dissolved only five, namely, titanic, arsenious and arsenic acids, teroxide of antimony, and oxide of zinc; it had no action on carbonates, and dissolved only one sulphide, that of antimony, and two chlorides, those of phosphorus and tin. These results show that liquid hydrochloric acid gas has much less action on solid bodies than the same substance when combined with water; this is very remarkable in some cases, as that of lime, where a true hydrogen acid and a powerful base, each in a pure state, and both possessing, under ordinary circumstances, a most powerful mutual affinity, do not react on one another, but remain perfectly uncombined, although one is a liquid and the other a porous solid, and they are brought into intimate contact by the enormous pressure requisite to condense the gas, forcing the liquid into the porous solid.

In consequence of the mode of experimenting, the substances operated on by the liquefied hydrochloric acid were of necessity exposed to the action of the same substance, in the form of gas, before it was condensed into a liquid; and it appears that, in many cases, the action exerted during the experiment was due rather to the influence of the gas than that of the liquid acid, which appears to be remarkably inert. As a remarkable instance of the power of glass to resist pressure, Mr. Gore mentioned that tubes charged with liquid carbonic acid in 1860 had not suffered any loss by leakage up to the present time.

GEOLOGICAL SOCIETY.—*May* 24.

On the Date of the Formation of the English Channel.—Mr. J. Prestwich read a paper on this subject, in which he expressed his opinion that the break in the land between France and England was not the result of the last geological change, but that the channel existed at the period of the formation of the Low-level gravels of the Somme and Thames Valleys, and probably at that of the High-level gravels. During a recent visit to the Sangatte raised beach, he recognized fragments of chert in the shingle and associated sands, which he inferred were derived from the Lower Cretaceous strata; associated with them were fragments from the Oolitic series of the Boulonnais and two pebbles of red granite,

probably from the Cotentin. These facts seem to prove that, before the Low, and possibly even before the High-level Valley-gravel period, there existed a channel open to the westward, and extending between France and England. Above the Sangatte raised beach occurs a mass of chalk and flint-rubble, with beds of loam, from twenty to eighty feet thick, and containing land-shells. Mr. Prestwich considered this accumulation analogous to the loess, which it resembles in general character, while the shells found in it belong to species common in that deposit.

The Formation of the Weald and the Deposits in the Medway Valley.—A very interesting paper, by Messrs. Le Neve Foster and Mr. Topley, on the denudation of the Weald, was read, describing the superficial deposits of the valley of the Medway. They showed that deposits of river-gravel and brick-earth (loess) occur at various heights up to three hundred feet above the level of the river. They also gave a detailed account of those singular formations known as "pipes" at Maidstone, where brick-earth (loess), containing land and freshwater shells and mammalian remains, have been let down into deep cavities in the Kentish Rag, probably by the gradual dissolving away of the limestone by the action of rain-water containing carbonic acid.

The paper was intended mainly to show the light that is thrown upon the theory of the denudation of the Weald by a study of the superficial deposits. The authors stated their objections to the theory of fracture and the marine theory, and endeavoured to prove that the gravel and brick-earth (loess), occurring at a very great height above the level of the Medway, are old alluvia of that river. If this point be granted, it follows that the denudation has been effected by atmospheric agencies, *i.e.*, rain and rivers, and that there will be little difficulty in supposing the present inequalities of surface in the Weald to have been produced by these agents. The escarpments of the chalk, which are, upon the marine theory of the formation of the Weald, regarded as sea-cliffs, are considered by the authors as being due entirely to the difference of waste of the hard and soft formations under atmospheric denudation.

June 7.

On the Former Occurrence of the Musk Ox in Low Latitudes. A short paper, by Monsieur Lartêt and the late Mr. Christy, describing a phalange of the musk-ox (*Ovibos moschatus*), which was discovered by them in the Gorge d'Enfer. With it were found remains of *Ursus spelæus*, reindeer and aurochs, as well as worked flints, differing from those found in any other of the Dordogne caves. Monsieur Lartêt remarked that the Gorge d'Enfer is the most southern locality at which remains of *Ovibos moschatus* have yet been found, and is fifteen degrees south of its most southern limit at the present day; but reindeer remains have been found by Mr. Christy and himself further south still, on the northern slope of the Pyrenees.

PROGRESS OF INVENTION.

A NEW CONSTANT BATTERY.—The improved constant battery of M. Blanc Filipo is deserving of attention, being well adapted for the purposes of telegraphy. It requires but one fluid, which may be a mere solution of common salt. This battery may be constructed by placing the saline solution in a tolerably tall glass jar, and adding to it powdered sulphur, so as to form a layer of moderate thickness at the bottom. The positive metal consists of a ring or cylinder of zinc, which is immersed in the fluid, but not so as to come in contact with the sulphur; and is suspended by a wire, which passes up through a cork in the neck of the jar, and forms the positive pole. The negative metal consists of a plate of lead, or tin, which dips down into the layer of sulphur—being slightly coated with sulphuret of copper, where it comes in contact with the sulphur, and covered with an insulating substance, when it approaches the zinc. A wire from this also passes up through the cork, and forms the negative pole. The mode of action of this battery is very simple. The hydrogen which is evolved at the negative pole unites with some of the sulphur—though the latter is insoluble, and a non-conductor—and forms sulphuretted hydrogen, the sulphuret of copper taking a part in the process which is indispensable, though it is not as yet understood. When the sulphuretted hydrogen comes in contact with the chloride of sodium, there results a double decomposition, sulphuret of sodium and hydrochloric acid being formed. The latter dissolves the zinc, and the resulting chloride of zinc is changed into sulphuret, by the sulphuret of sodium, which again becomes a chloride. During these changes, a small quantity of sulphuretted hydrogen is evolved; and this appears to be the only objection to which this battery is liable. In other respects, it possesses some important advantages; it is very economical, both as to the kind and amount of the substances required; it occupies but little space, and it continues in action a long time. Other metals may be substituted for the zinc; but in every case the salt used in the solution must be incapable of decomposition by sulphuretted hydrogen, or of precipitation by the metal which is substituted.

PURIFICATION BY MEANS OF ELECTRICITY.—The fat obtained from bones constitutes an important article of commerce; it is, however, obtained in a state of great impurity, and its purification is extremely difficult. The idea occurred to Dr. Dullo of using electricity as a means of freeing it from the substances—chiefly gelatine—which render even what is obtained from fresh bones extremely nauseous, but which, fortunately, are decomposed by the electric current, that, at the same time, exerts no action on the fat itself. His process consists in gently heating the fat to about 40° Cent., in a clean copper vessel, free from roughness in the interior. Sulphuric acid, diluted with ten times its volume of water, is added, to an amount dependent on the degree of impurity which is to be

removed, and is well stirred in. A plate of zinc is then introduced into the mixture, and is made to come into contact with the copper vessel, at as many points as possible—the surface of the zinc being about equal to half that of the copper. The current of electricity thus produced causes a foaming, which is great in proportion to the amount of impurity; and the gelatinous constituents are dissipated in the form of gas, or are retained in the water, and removed when the action ceases. After the fat has been drawn off, it is allowed to settle; and, having been separated from the matters which subside, it is filtered, after which it is quite pure, and ready for sale or use.

New Mode of Whitening Wool.—The beautiful white wool produced in this country has long been the envy of continental manufacturers, and many attempts have been made to rival it, not altogether without success. A process recently invented in Germany seems to have left nothing further to be desired on the subject. The wool to be bleached is steeped in a strong neutral solution, containing sulphate of magnesia, amounting to the one-twentieth of the weight of the wool; and this solution is decomposed by the addition of bicarbonate of soda, equal to seven-tenths of the weight of the sulphate of magnesia—the mixture being then gently heated to about 90° Cent. Basic carbonate of magnesia precipitates, and the larger portion of it attaches itself to the fibres of the wool, rendering them extremely white, without impairing their softness; carbonic acid is evolved.

Novel Application of Capillary Attraction.—Capillary attraction has been applied by M. Duclos to the reproduction of drawings, etc., by means of processes which are founded on the fact that, if a silvered plate of copper is written on with an unctuous or resinous substance, and afterwards subjected to the action of mercury, that fluid will adhere to the uncoated portions and form projections rising considerably above them; so that, even when the excess of mercury is carefully removed, it will still remain in relief, and a copy of the plate in this condition can be taken, from which may be obtained an electrotype that, if printed from, will afford a fac-simile of the drawing. M. Duclos, in practice, replaces the mercury by a compound consisting of fusible metal and mercury. When this is melted and poured over the silvered plate on which the drawing has been made, it comports itself exactly like the mercury; but, being harder, when cold, an electrotype may be obtained from it directly. When, however, this compound is used, great care must be taken to prevent oxidation, which would be, at a subsequent period, highly inconvenient; hence the plate is immersed in sufficiently heated oil, when the fused metal is being poured upon it. An amalgam of copper, applied to the silvered plate by means of a roller of silvered copper, is also used instead of the mercury; and when it sets, an electrotype may be had from it. Various modifications are employed when plates for surface printing, etc., are required.

Photographic Engraving.—Photography has been applied in a novel way to the production of engravings. A photograph is first obtained. For this purpose some good fabric of silk is immersed

in a solution of gum tragacanth and gluten, then dried and rolled; after which it is coated with a solution of caoutchouc in benzole. It is next spread out on glass, and, having been inclosed in a frame, is left to dry. It is then sensitized with perchloride of iron and tartaric acid, and a picture is printed on it in the usual way. The development is effected by a mixture consisting of two parts double salt of gold and three parts gold in powder; a current of hydrogen is next thrown upon it to reduce the metallic salt, after which the silk is separated from the glass. The side of the silk containing the picture is now pressed against a plate of clean copper, which has been previously coated with a mixture consisting of concentrated chloride of zinc, borax, carbonate of ammonia, and gum, and has been allowed to dry until the coating becomes sticky; it is then rubbed with a damp sponge, after which the silk is drawn away. The picture remains on the plate; and the flame of a soldering lamp having been thrown upon it, it is exposed in a camera. The design, damascened in gold, is thus obtained on the copper plate; and when the latter is acted upon with a solution containing ten per cent. nitrate of silver—which does not eat under the protected portions—a film of copper is removed from the uncovered portions. The silver thus reduced is taken away by washing, and the plate is again exposed to the action of the nitrate; the same thing being repeated a number of times in succession, until sufficiently deep hollows have been formed.

Application of Heat in Mining.—The use of heat, in the crumbling down and removal of rocks, is of very ancient date; it has been latterly applied in the mines of the Hartz mountains, very advantageously, to the separation of considerable masses of ore. For this purpose, a small furnace is placed against the face of the rock containing the mineral, and the coke with which it has been supplied is kept in a state of ignition for some hours; after which the furnace is withdrawn, and the heated portion of the rock is sprinkled with water. In a short time a large mass separates, and an additional quantity not long after. On the whole, a mass several inches in depth, and of considerable weight, is thus removed, and at a cost fifty per cent. less than if gunpowder had been employed.

Erasine.—Grease, etc., is readily dissolved by benzine; but the latter has the disadvantage of an offensive odour. A new substance has, however, lately been discovered which possesses the useful properties of benzine, while, at the same time, any odour it emits is agreeable. It has been called *Erasine*, and is the product of a species of pine, accidentally discovered by some persons who were collecting turpentine, and remarked that none could be obtained in the usual way from certain trees; but instead of it, a juice possessing the power of dissolving all animal and vegetable oils, without leaving any stains, or injuring the most delicate colours. Erasine has already found its way into commerce, and it would answer well for burning in lamps, but that it is too dear.

Newly-observed Source of Magnetism.—A source of magnetism has been discovered which, it is probable, has not been remarked before; and it is the more deserving of attention since it seems to

excite permanent polarity in soft iron, an effect which cannot be produced either by touch or by the electric current. It was noticed, at the central workshop of the Nassau Railway, that not only shavings of steel, but even of soft iron, produced in the lathe, were sensibly magnetic, and that, whatever their lengths, they exhibited two poles. It might be supposed that the nature of the polarity would depend on whether the helix formed in this way turned to the right or the left; but such was not found to be the fact—though, at the same time, the effect seemed to be modified by that circumstance, as, in all those instances in which the spires, looked at from their south pole, were in a direction opposite to that in which the hands of a watch move, the magnetism was stronger than in the others. The relative position of the poles was, however, found to depend on a totally different circumstance; since the south pole was invariably situated at that extremity where the cut had been commenced; and the north, at that at which it had terminated.

New Lens for Photography.—An achromatic lens, which seems to be peculiarly suited to the purposes of the photographer, is formed by the combination of two concave menisci of crown glass, the focal lengths of which are as one to three, having between them a flint glass lens. The contiguous surfaces are of exactly the same curvature, and therefore are perfectly in contact. Such a lens is found to produce a clean, undistorted picture. It will cover an extent of about 92°; but it will define well, and illuminate uniformly an angle of 80°, with a stop one-thirtieth of its focal length; and an angle of 60°, with a stop the one-fifteenth of its focal length. It is less bulky than the ordinary lenses, and must be very durable, since both sides of the flint glass are protected by hard crown glass.

Rails of Steel and Iron Combined.—Soft iron is objectionable in the rails of railways, on account of its inferior strength and rapid wear; steel is, generally speaking, too expensive; but a means has been devised in America, a short time since, of uniting the strength and durability of the one with, to a great extent, the economy of the other. The rail is made, lengthwise, in two portions, which, when placed beside each other, and firmly bolted together, leave at the upper edge a longitudinal groove, capable of receiving and holding firmly a bar of steel. If the latter has been inserted before the iron portions have been united, a rail will be obtained in which the parts exposed to the action of the wheels is of steel; and is not only very durable but, when worn, is capable, with great ease, of being replaced, the remainder of the rail being as available for use as ever. The bar of steel being made to traverse the joints of two or more of the compound rails, it binds them together, giving great firmness, and rendering the chances of displacement of the rails almost nothing. The iron portions of each rail are so formed, with hollows and corresponding projections, that they cannot slide in any way upon or from each other; and when all the parts are united, they present an appearance differing but little from that of the ordinary rail.

THE REFLECTION OF LIGHT EMPLOYED TO INDICATE CHANGES OF TEMPERATURE.—Dr. Boulon, of Paris, uses the reflection of light very ingeniously, for the purpose of making very slight changes of temperature distinctly visible, by their effects, to a large audience. He employs a thermo-electric battery, which is so arranged that the electric current produced by changes of temperature is transmitted through the helix of a galvanometer, the needle of which has, fixed upon its centre, a very small mirror. Opposite to this mirror is a large screen, in the middle of which is a small aperture, through which a ray of light from a bright lamp behind it passes to the small mirror in front of it. When the plane of the mirror is exactly perpendicular to the direction of the ray from the aperture in the screen—that is, when there is no electric current to deflect the needle of the galvanometer—the ray is reflected back again through the aperture. But the smallest current deflects the needle, and therefore turns the mirror round in one direction or the other; and the ray, instead of passing back through the aperture, is thrown on the screen to the right or left of it. The most minute changes of temperature are thus rendered distinctly and easily, cognizable by any number of persons, in a large lecture-room.

NOTES AND MEMORANDA.

MUSICAL FROGS.—The author of that excellent book, *Ten Years in Sweden*, speaks of the *Bombinator igneus*, a little frog that has become naturalized in that country, as emitting, during the pairing season, a note like the ringing of bells. He says, "As this sound proceeds from the depth of the water, it appears to come from a long distance, although the frog may be within a few fathoms." Linnæus spoke of the same reptiles making sounds as if large bells were ringing in the distance. It would be very interesting to naturalize the little creature in this country.

NEW PLANET.—M. de Gasparis has discovered another new planetoid on the 26th of April, which, in honour of Dante, has been named Beatrix.

THE OBLIQUITY OF THE FLOUNDER.—Professor Steanstrup has obtained specimens which show that in its early stages the flounder is a symmetrical fish, with one eye on each side of its body. As it grows, both eyes pass to one side, in which they have a curious oblique arrangement. He says, "The symmetrical fish by degrees squints its eye in and up through the head out to the other side, and at last squints itself into a perfect flounder." Professor Wyville Thompson, who has recently examined Professor Steanstrup's collection of flounders in various stages, confirms the main fact, but suggests in the *Annals of Natural History* a more probable mode of effecting the change than the passage of the eye through the vault of the cranium, as conceived by Steanstrup, with whom he agrees in rejecting Van Beneden's hypothesis, that it is produced by a simple torsion of the anterior portion of the head. From various considerations, he thinks that "the eye of the blind side passes to the eye-side, not through the vault of the head, but under its integument, displacing in its progress the frontal bone on its own side. . . . The term 'migration' of the eye is of course used in a somewhat metaphorical sense. The eye changes little in *actual* position. With the growth of the fish the associated parts are, as it were, *developed past it*, producing this singular obliquity."

PRESERVING STAR-FISHES, CRUSTACEA, ETC.—Mr. Verrill, writing in *Silliman's Journal*, recommends that these objects should be immersed in alcohol of moderate strength for about a minute, and then dried rapidly by artificial heat, taking care not to let the temperature come too near the boiling-point, at which green shades change to red.

AGE AT WHICH NEW MOON IS SEEN.—Mr. D. A. Freeman writes to us from Menton (*Alpes Maritimes*), stating, in reply to the query of a correspondent, which we published in a former number, that on the 28th of January he observed the moon shortly after sunset, when it was but thirty-two hours old, and he was informed by the bailiff of the property on which he is residing, that about twelve years ago he saw the thin crescent of the *old* moon above the horizon before sunrise, and on the same evening, at the same height above the sea-level—from 100 to 150 feet—he saw the thin crescent of the *new* moon after sunset.

GODDARD'S MICROSCOPE CABINETS.—Mr. Goddard has devised, and Messrs. Ford and Sharratt have made, a new pattern cabinet for microscopic objects, one of which has been sent to us for examination. The outside of this cabinet is of mahogany, and the trays which, according to size, hold twenty-four or forty-eight slides lying flat, are of millboard, strengthened by mahogany edges. This construction enables the cabinets to be offered considerably below the price of the best mahogany patterns, and the Goddard cabinets come into competition with those of varnished white deal, which were, we believe, first introduced by Messrs. Crouch, and which were noticed in a former number. In point of workmanship, those of Messrs. Crouch appear to us the best, but the outer case being of mahogany in Mr. Goddard's pattern, is an advantage in point of strength.

STEINHEIL ON DIVIDING BRIGHT DOUBLE STARS.—In the *Astronomische Nachrichten*, No. 1525, is a letter from Steinheil, in which he remarks that "it is a known consequence of the diffraction of light that fixed stars appear as light discs of measurable diameters. These diameters stand in relation to the intensity of the light, and the proportion that exists between the aperture of an object-glass and its focal length," so that a telescope of eight inches aperture and twelve feet focal length, with which Dr. Engelmann could not divide γ^2 Andromedæ, "would necessarily give to the component stars larger diameters than one of the same aperture, and shorter focal length." Dr. Steinheil gives a diagram to show the ratio in which the apparent discs of stars—as seen through telescopes—increase in proportion to their brightness, and he states that by reducing the brightness, with the aid of a light moderator he has introduced, the discs may be diminished, and difficult stars divided. This light moderating glass is held in the hand between the eye and the eye-piece. As an illustration of the fact that dividing power increases with the ratio of aperture to focal length, Mr. Webb mentions that he has this spring seen the close pair of ζ Cancri distinctly separated with a black interval, with one of Mr. With's 8-inch silvered glass specula of 6 feet focus (power about 300), which Dr. Engelmann's achromatic of 8 (French) inches aperture and 12 feet focus would only elongate, and that not very distinctly, in April, 1864. Dembowski gave its distance about that time $= 0''{\cdot}5$, but this was probably too small, as it has been recently measured by Mr. Dawes $= 0''{\cdot}63$, and seems to have been closing up for several years. In the *Astronomical Register* for June, Mr. Dawes affirms that nothing can be easier than to prove that the diameter of star discs does *not* depend on the ratio of aperture to focal length. As Dr. Steinheil is a mathematician as well as a famous maker of telescopes, Mr. Dawes should furnish the disproof he mentions.

RESPIRATION OF PLANTS.—It has been found by recent experiments that carbonic acid is not decomposed by plants, even in the light, unless it is diluted with atmospheric air, oxygen, hydrogen, or nitrogen. Analogous conditions are required in other cases; thus phosphorus is not oxidized nor rendered luminous by oxygen, unless atmospheric air, nitrogen, or hydrogen also is present; neither will oxygen support respiration, but, on the contrary, will cause asphyxia, unless it is diluted.

GREAT HAIL STORM, MAY 7, 1865.—In *Comptes Rendus*, No. 20, will be

found an account of the great storm of the 7th of May, as it operated in the valley of the Scheldt. The most remarkable feature was the enormous quantity of hail. M. Lermoyer states that at Vendhuile the hailstones were as large as musket-balls, at Catelet they reached the size of a pigeon's egg, and even of a fowl's egg; these great ones being composed of agglutinations of those of smaller dimensions. The storm of hail and rain began at 4h. 30m. p.m., and was accompanied by formidable whirling gusts of wind. A ditch attached to the canal of St. Quentin, and which received the drainage of 500 hectares (about 1235 square acres) of land, was so overfilled by the hail and rain as to overflow the high bank of the canal, and sweep into it 800 hectolitres of firewood, obstructing the navigation. The hail formed a congealed mass 462 metres long, and 20 in mean breadth, or about 459 yards long, and nearly 22 broad. "This deposit constituted a veritable glacier on which it was safe to walk." When a channel was cut through it, detached masses floated down like icebergs above the bridge of Vendhuile, the meadows of Ossu were covered for a mile and a-half with a mass of hailstones more than 200 yards wide. It was observed that during this storm vanes placed on heights indicated north-east currents, while those in the plains showed south-west.

On some Properties of Nitric Acid.—M. Dietzenbacher informs the French Academy that very remarkable oxydizing powers are exhibited by heating a mixture of fuming nitric acid and Nordhausen sulphuric acid. Charcoal and lamp-black burn energetically in such a mixture. The acids, mixed in equal proportions, transform cotton in a few seconds into pyroxylin, insoluble in ether or alcohol; thus prepared it burns instantly, leaving no residue. Cotton partially submerged ignites and discharges thick vapour. Zinc, which is energetically attacked by concentrated nitric acid, remains for days in the mixed acids without alteration. The mixture is equally inactive towards iron, copper, and tin; the iron does not become passive.

Preservation of Wines.—M. Pasteur recommends that the disorders of wine, which are occasioned by parasitic ferments, should be arrested by heat. He bottles the wine, wires the cork, and exposes it in a hot-air stove to a temperature of from 60° to 100° C., or 140° to 212° Fahr. The cork, which is partly driven out by the heat, is replaced when the wine cools and sealing-wax applied. M. Pasteur states that this process prevents the action of the ferments, and has not broken a single bottle in his experiments. M. de Vergnette-Lamotte, who made independent experiments, also recommends the application of heat. Of course some years must elapse before the effect of the process can be fully known. According to M. Lamotte, a temperature of 40° C., or 104° Fahr., rapidly causes wine to assume the properties conferred by age.

Phosphorescence at Sea.—On the 4th of September, at nine p.m., M. B. Coste noticed in lat. 9 N., long. 50 (French), what the French sailors call a "sea of milk" (*mer de lait*). It approached the ship in the form of a great sheet of white phosphorescent water, looking as if the sea were covered with snow as far as the horizon. The appearance was occasioned by myriads of minute gelatinous creatures, which he denominates *noctiluca miliaris*, though his description does not indicate that animal, which is nearly spherical, while those he saw were like "little straws covered with silver." Contrary to what is usual, and what he had noticed before, the furrows made in the water by the passage of the ship were dark and not luminous.

Monochromatic Light for the Microscope.—The Abbé Count Castracane states that by employing M. Foucault's heliostat and a prism of large dispersion, he illuminates the *Pleurosigma angulatum*, or other objects with any kind of monochromatic light. In the case of the *P. angulatum* he finds a bluish green exhibits the markings with a much lower power than when white light is employed. The account of the experiments, which we find given to us in the *Archives des Sciences*, is not intelligible to us as regards the powers employed. It says that with white light the fifth and strongest objective of an Amici microscope was necessary to resolve the markings of the diatom, while the third objective would do it with the monochromatic rays.

APPLICATION OF THE SPECTROSCOPE TO THE MICROSCOPE.—At the last meeting of the Microscopical Society, Mr. Browning read a paper on this subject, illustrated by numerous diagrams, showing the admirable arrangements he had devised. In one form of his apparatus a prism of peculiar shape possesses a small dispersive power in one direction, and a larger one in another, the rays having in both cases the same angle of emergence. By changing the position of this prism, it acts as a prism of smaller or greater angle, and is thus adapted to two classes of investigations, one needing less dispersion than the other. In Mr. Browning's method of mounting, the spectroscope can be used under the condenser or as an eyepiece. Probably the best eyepiece arrangement will be a direct vision prism of the sort made for Mr. Gassiot's electrical experiments. This gives a small dispersion adapted to show absorption bands in fluids, and when more dispersion is required, two prisms can be employed. Mr. Browning exhibited a spot of blood upon a card, about the size of a full stop in very small print, and stated that with one of his spectroscopes applied to the microscope Mr. Sorby had obtained a characteristic spectrum. In Mr. Browning's arrangements the spectra of opaque objects are easily seen, and blood globules or minute transparent cells observed more commodiously than is possible in the adaptation of the star spectroscope to the microscope, in the mode adopted in Mr. Huggins' important experiments. Mr. Glaisher, the President of the Microscopical Society, and Mr. Wenham spoke in the highest terms of Mr. Browning's arrangements.

NEW LIVING OBJECT TRAP.—Mr. Richard Beck described and exhibited at the last meeting of the Microscopical Society an ingenious contrivance for caging small creatures such as mites, with a view to their convenient examination. He drills a hole in a glass slide of the dimension required, and by a small piece of mechanism presses a strip of thin glass above and below the hole, so as to form a top and bottom to the little cell. The apparatus is reversible, so that the entrapped creature can be examined either way up. A series of these live traps fit into a small mahogany box, and will be found very convenient for processes of research, in which it is necessary that a small live object should be confined to a small space, but not injured. Water can easily be introduced into the little cells when required.

NEW LIEBERKUHN.—Mr. Richard Beck likewise described and exhibited a new form of illuminator, consisting of a parabolic silver reflector, which slips on to the brass work of an objective, and presents somewhat the appearance of half a large lieberkuhn. It performs the function of the side silver reflector, and by special arrangements, which Mr. Beck described, it allows an object to be illuminated by nearly vertical rays. For some investigations Mr. Sorby found this illumination essential to success.

PRODUCTION OF ORGANISMS IN CLOSED VESSELS.—No. 74 of the *Proceedings of the Royal Society* contains an account of a series of experiments apparently made with due precaution by Dr. G. W. Child on the production of organisms in vegetable infusions which had been boiled, which were closed after receiving a supply of air that had passed through red hot porcelain tubes. Notwithstanding these conditions, small bacterium bodies appeared, and Dr. Child states that organisms such as occurred in his vessels could not have been detected by the low powers employed by M. Pasteur. His conclusions are "either that the germs of bacteriums are capable of resisting the boiling temperature in a fluid, or they are spontaneously generated, or they are not organisms at all." He believes they are really minute vegetable forms, which is certainly the case in some specimens, though it is possible mere physical aggregations of minute globules may sometimes be taken for real bacteriums. He looks to Messrs. Powell and Lealand's $\frac{1}{50}$th as likely to elucidate the structure of these objects.

PASSAGE OF DARK BODY ACROSS THE SUN.—M. Le Verrier communicated to the French Academy a letter from M. Aristide Coumbary, stating he had observed at Constantinople on the 8th of May, about 9·23 a.m., a small dark body slowly passing across the solar disk.

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